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IRON WORK.

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W. GRIGGS,

HANOVER STREET, PECKHAM,

LONDON, S.E.

The Journal of Indian Art and Industry.

WOOLLEN FABRICS OF THE BOMBAY PRESIDENCY.

By B. A. BRENDON, Esq., I.C.S.

The woollen industry in this Presidency, in so far as native enterprise is concerned, is confined to the manufacture of blankets, carpets, rugs, felt and sacking. Blanket-weaving is carried on to a greater or less extent in every district except Kánara, and felt-making is also equally well distributed. Carpets are made at a few factories in and near Ahmedabad and at one place (Bubak) in the Karáchi district in Sind. Rugs and sacking are made exclusively in Sind, where the industry exists in every district.

There is no good class of wool grown in the Presidency. The staple is generally coarse and short and the fleece full of hairs, technically known as "kemps," which will not "felt," and which protrude from the surface of the fabric when woven. Felting, or milling as it is also called, is a technical name for a process which is commonly known as shrinking, and is that process by which the threads in a fabric are so closely drawn together that they are practically indistinguishable from one another. Hair, unlike wool, will not shrink, nor has any machinery been yet invented for the separation of these kemps from the wool fibres. In a coarse blanket the presence of hair is an advantage, but in a cloth it is a great defect, and though it cannot be avoided in working with Indian wool, the appearance of hair is removed by passing the cloth under an extremely sharp knife, which shaves off all the projecting hairs. In the case of Cashmere wool, which has a very fine staple, kemps are removed to a certain extent by hand: a tedious, costly and at best inefficient method, for a large number of hairs are certain to remain with the wool.

The first process through which the raw wool has to pass, after being sorted, is cleaning. This is generally performed by Mahomedan Pinjáris using the bow (*kamán*). The term used does not express the nature of the operation as well as might be wished, though it is hard to find a better. The purpose of the operation is somewhat analogous to that of "ginning" in the cotton industry and it corresponds to a very limited extent to that of "carding" in an English woollen mill. The application of either of these terms to the operation in question would be illegitimate. The instrument is suspended by a cord attached to the middle of the string of another bow of the ordinary kind, and this bow is fastened to a peg in the wall. By this means a certain amount of play is afforded to the instrument, which is so adjusted that the string of gut almost touches a heap of wool placed on the ground. The Pinjári then holding the instrument in his left hand, presses it down until the gut just touches the heap of wool, and at the same time he strikes the gut with a short wooden club shaped very much like a dumb-bell. The vibrating gut takes up a little of the wool and the instrument is allowed to rise clear of the heap; a second or third stroke of the club frees the gut of the clinging fibres, which are thrown to a short distance, separated from all the heavier impurities which fall back on the heap. The *kamán* deals effectively with the tangled fibres in a fleece, though it fails to remove all the burrs which proverbially cling to a sheep's back in great numbers. A Pinjári charges about one anna for cleaning a seer of wool.

One of the weaver's family, generally a woman or a boy, next proceeds to spin the wool into yarn. The spindle is turned by a cord passing over a roughly shaped driving-wheel, which is turned by hand. The spinner takes in his left hand a quantity of raw wool, which he connects with the point of the spindle by a short length of yarn previously spun or roughly twisted in his hands for the purpose. Then, as he begins to turn the wheel, he slowly withdraws the handful of wool away from the spindle as far as he conveniently can. There is now a length of perhaps two feet of quivering twisting yarn between the spinner's hand and the point of the spindle. As soon as this is sufficiently spun, the operator's arm relaxes and the yarn is allowed to coil itself on the still turning spindle. Then the hand containing the unspun wool is again withdrawn and the operation recommences.

The yarn has next to be warped. The first thing to be done is to measure off the requisite number of threads or "ends," each of the proper length, which will be slightly greater than the length of fabric to be woven. The instrument consists of seven upright pegs fixed in a wooden base. There are two parallel rows of three pegs each, and there is one peg between these rows. The warper, sitting beside the instrument, passes one end of the yarn through a piece of hollow cane, and makes the end fast to one of the end pegs. The object of the hollow cane is to enable the warper to reach all the pegs without moving. Calling the peg to which the yarn is tied No. 1, the other peg at the same end No. 7, the two middle pegs Nos. 2 and 6 respectively, the two at the further end Nos. 3 and 5, and the centre peg No. 4, then the yarn is passed round outside the pegs in their numerical order as far as No. 7, when, instead of being carried on to No. 1, it is brought back in the reverse direction, with this difference, that instead of passing outside all the pegs, it is now passed inside the two middle pegs No. 2 and 6. At each of these two points, therefore, the yarn crosses and recrosses, forming a loop, technically called a lease. The distance round the pegs and back again is the length of the warp.

The next step is to remove the yarn. This would be a tedious process and would certainly result in destroying the order of the threads, if not in breaking some of them, if it were attempted while the yarn was stretched. The centre peg No. 4 is, therefore, pulled out, and the slackened threads are then easily removed; the leases being preserved by previously inserting a piece of cord through each of the loops formed at the middle pegs Nos. 2 and 6 and tying the threads together. Through the loops at each end of the threads a bamboo rod is now inserted, of sufficient length to admit of the threads being arranged on it according to the number required per inch of width of fabric. One of these rods is then secured to two pegs in the ground and the other is fastened by a rope passing over a trestle to another peg in the ground or wall. By raising the trestle into a vertical position, the warp threads are stretched tight, and they are then arranged at their proper distances from each other.

The warp is now ready for sizing. The sizing paste is generally made of crushed tamarind seeds boiled in water, though in some places, probably where tamarind seeds are not to be had, a paste made of *kodri* or *ragi* flour is used. After being sized and allowed to dry, the warp is taken as it is to the loom. The thin rod is fastened to the weaver's beam and the stout rod becomes the back beam of the loom. But before this is done the reed has to be placed in position. For this purpose the warp is slipped off one of the rods and the threads drawn through the divisions of the reed, which is hanging from a beam in the roof, and the rod is then passed through the loops and fastened in position. The next step is to affix the healds, one set of which is attached to the upper threads and the other to the lower threads. The healds are suspended as shown in the illustration, and are worked by treadles underneath. As one set of healds is depressed, the other set is automatically raised by the bar from which both are suspended, so that the original upper and lower threads alternately change places. After every cast of the shuttle, the weft is beaten home with the reed and the healds reversed. The shuttle is generally a bobbin fixed in a piece of split cane, of which both ends are closed, or in a piece of buffalo horn; but sometimes is simply a short length of hollow cane, of which one end is open, and in which the woollen yarn is placed in a ball at the bottom. The weft yarn is not sized at all in most places, the only reported exception to this rule being Ratnágiri, where it is said that the weft yarn is dipped into the ordinary tamarind seed paste and used while still wet in order that the threads may lie closer to each other. In other places the weft yarn is used after being damped in water or more generally quite dry. As the weaving proceeds the weaver from time to time slackens the rope by which the back beam is held in position and winds the woven portion on the weaver's beam; after which the warp is again tightened by the rope fixed to the back beam.

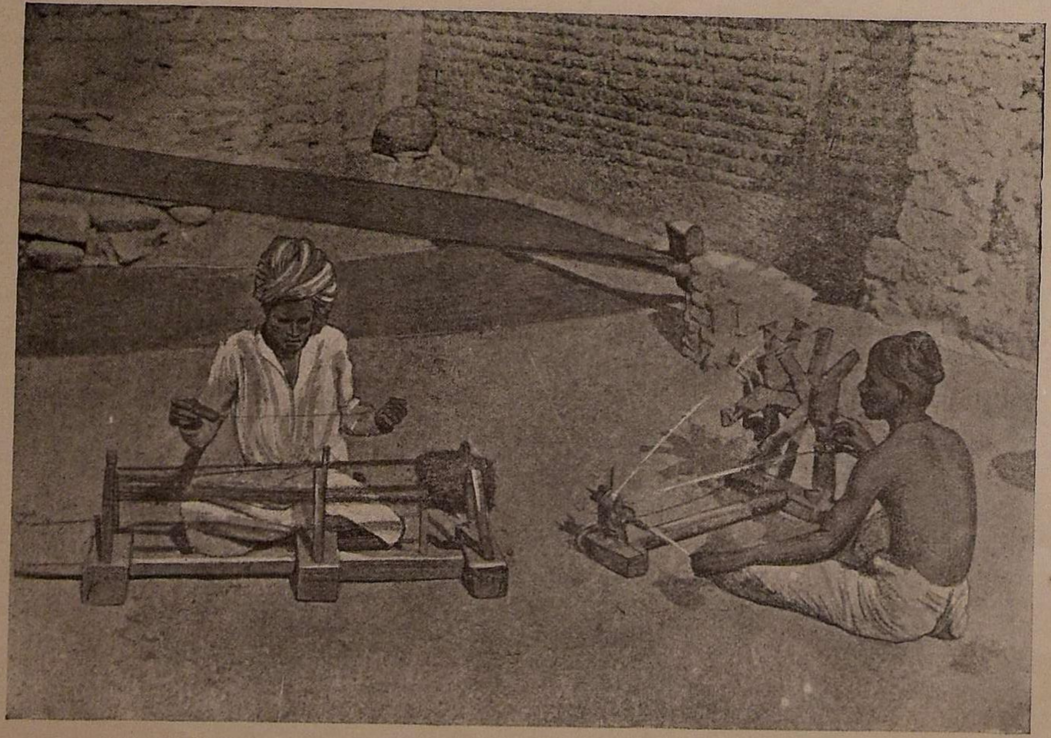
Carpets and Rugs.—Woollen pile carpets are made in the prisons at Yerowda, Thána, Ahmedabad, Karáchi, Hyderabad and Shikárpur; also in a few factories in and around Ahmedabad, and on a small scale at Bubak in the Karáchi district. A few are also turned out at the Sir J. J. School of Art in Bombay.

The method in all these places is much the same. The loom is a vertical frame consisting of two upright beams fixed in the ground 12 or 14 feet apart. Between these beams there is a pit 3 feet wide and of the same depth, in which the weavers sit or dispose of their legs when working at the commencement of the carpet. The upright beams are from 6 to 10 feet above the ground. Between them, at the top and bottom, are fixed two horizontal beams, which are capable of being turned by a lever, and between these beams the warp is stretched. The warp is generally cotton yarn of some coarse count, several strands being twisted together for the sake of strength. Cotton is simply used on account of its cheapness. The only place where a warp of woollen yarn is used is the Bombay School of Art. The warp yarn is first arranged on two upright pegs fixed in the ground about 3 feet further apart than the length of the carpet to be woven, to allow for contraction during weaving and wastage at both ends. The threads are laid on, to the number required for the width of the carpet, in such a manner as to cross each other midway between the pegs at each turn. At either extremity, on the outer edge of each peg, the threads are laced together to preserve their relative order. The requisite number of threads having been arranged on the pegs, one peg is removed to slacken the warp, which is then slipped off the other peg. Through the loops at either end of the threads a bamboo rod is inserted which is long enough to hold the warp, when the threads are arranged according to the requisite number per inch. The rods are then fastened to the upper and lower beams of the loom respectively and the warp tightened by being wound on the upper beam, which is turned by a lever.

The next step is to attach the healds. These consist of two rods, one knitted by a series of loops to the back row of warp threads, and the other to the front row, both rods being connected in such a manner that the drawing forward of the one automatically relaxes the other. To maintain an equal tension upon the back and front rows of the warp during the repeated processes of reversing the heald, an ingenious device has been adopted. A rod, technically called a lease-rod, is inserted between the warp near the top beam of the loom. The heald is then reversed and another rod inserted in the new "shed" about 4 inches below the first. The warp threads cross each other midway between the rods. The lower lease-rod is prevented from slipping down by being secured at both ends to the upper lease-rod, which is held in position by the crossing of the threads below it. Everything is now ready for weaving. Usually one weaver is allotted to every 18 inches or 2 feet of width of carpet, and each weaver has a bundle of short lengths of woollen yarn of various colours hanging by him within easy reach. A prompter at the back of the loom reads out the pattern from a sample or diagram in front of him.

A few rows of the weft are first inserted by shuttle in the ordinary way with cotton yarn, in order that the warp threads shall not lose their relative distances. Each weaver, as his portion of the pattern is called out, taking a piece of woollen yarn of the right colour, passes an end of it between two strands of the front row of warp threads, carries it round the corresponding back thread on the right, brings it forward and again passes it in between the two front threads first mentioned, carries it round the corresponding back thread on the left and then forward once more, pulling the two ends downwards until the tie rests on the row below. These ends are then cut off with a knife about an inch from the web. As each row of such ties is completed, two or three weft threads of cotton or woollen yarn are woven in, forming the basis of the fabric and at the same time binding the pile. As explained above, cotton yarn is used in the warp and weft simply for the sake of economy. When the warp is of wool or silk, the binding weft threads are of wool, and such carpets are much more durable than those made with a common warp. From time to time the pile is clipped over with a pair of scissors to form an even surface, and the portion thus clipped is wound on the lower beam, the warp wrapped on the upper beam being unrolled to a corresponding extent. The pile, which varies from 3-16ths to 3-8ths of an inch in depth, completely hides the cotton or woollen threads, both in the warp and weft.

Pinjari cleaning wool with bow.

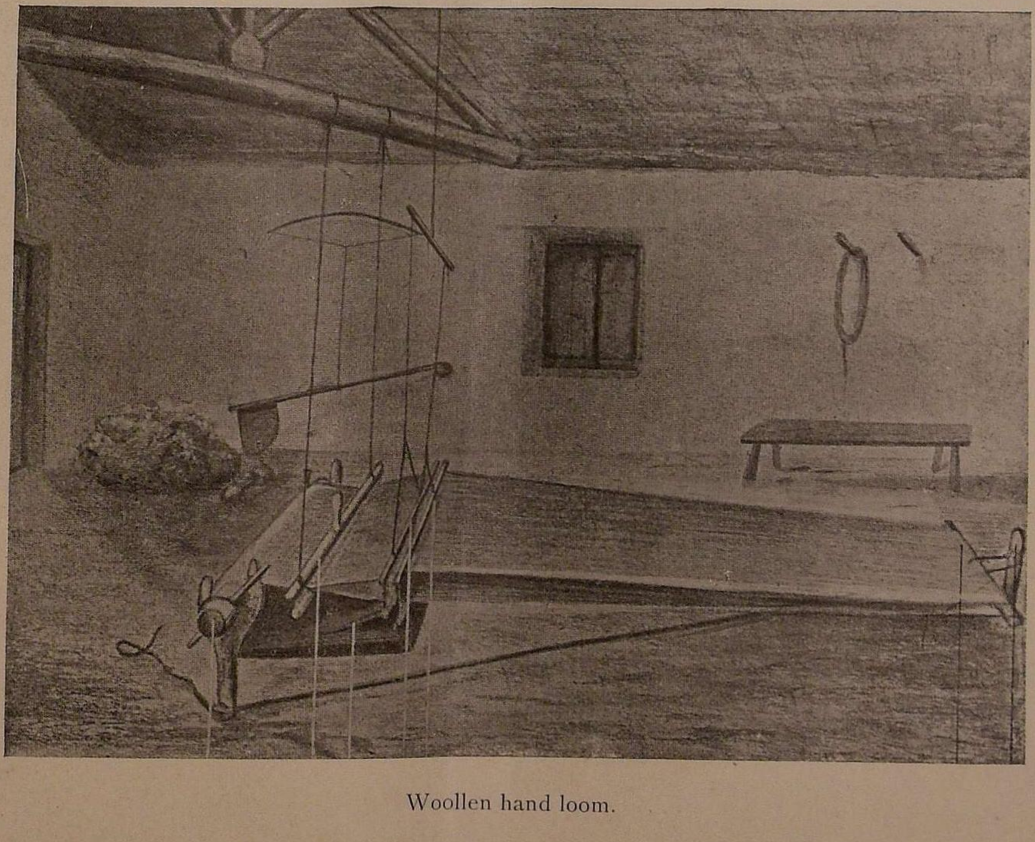


Measuring threads for the warp and spinning woollen yarn.

Sizing the warp.

10.—Woollen Fabrics of the Bombay Presidency.

Broach peasant wearing " Ghumti."



Woollen hand loom.

11.—Woollen Fabrics of the Bombay Presidency.

COTTON FABRICS OF THE BOMBAY PRESIDENCY.

By R. E. ENTHOVEN, Esq., I.C.S.

The production of cotton fabrics in Western India is of three descriptions. Firstly there is the outturn of the weaving mills and hosiery factories, of which the greater number are situated in Bombay Island. Next in importance is the work of the hand-weavers residing in all districts of Bombay, including Sind, with the exception of the Panch Mahāls. Thirdly, the majority of the jails produce hand-woven fabrics mostly superior in texture to similar cloths from the hand-looms of voluntary labourers. Several classes of fabrics are produced in the jails alone. Broadly speaking, the yarn in all cases is machine-made, the coarser counts being from the mills of the Presidency, and the finer counts imported from England. Hand-spinning is not extinct, but it is seldom relied on by professional hand-weavers for the supply of their raw material.

It is not possible to form any approximate estimate of the annual outturn from these three sources. The number of persons employed and their immediate dependents is probably about 750,000. The mills of the Western Presidency are three times more numerous than those in other parts of India, and supply a very much larger area than Bombay. To a certain extent also the hand-looms contribute to markets more distant than those of the neighbouring districts. Thus, there is an export from Bombay of hand-woven cloths to Muscat, the Arabian ports, and the East Coast of Africa.

Hand-Woven Cloths and the methods of weaving them.—Among the products of the hand-loom the *sari* stands first, being the most common and the most varied in texture, colour and design. The Indian *sari* is generally of an artistic tint, the result of judicious blending of colours in warp and weft. Red, green and blue are the most common colours. The borders of the cheaper *saris* do not vary much in design; but in the case of the better class goods made with silk borders there is a wider range of border patterns of delicate finish. The ends of all *saris* are generally of broad bands of colour which harmonize well with the rest of the garment. As a result, the *sari* becomes one of the most picturesque forms of apparel, and it is as gracefully worn as it is pleasing to the eye. After the *sari*, *cholis*, *pagaris*, *dhotars*, and coarse *dangari* may be said to form the backbone of the hand-weaving industry. *Cholis* are similar to the *saris* in colour and design. *Pagaris* are most frequently white or grey, but every shade is to be found, the order of the colours being red, yellow, green, blue and purple. They are worn in an endless variety of fashions—furnishing as a rule an indication of the caste or rank of the wearer. *Dhotars* have to compete with severe competition from the mills, and it is somewhat curious to find that they are still produced throughout so large a portion of the Presidency. Apparently there are many who continue to show their preference for the hand-woven *dhotar*, stronger and softer than the other. Probably its durability and the absence of the larger percentage of sizing with which the mill-made article is provided are the main reasons of the popularity of the hand-woven *dhotar*.

The common cloth, known as *dangari*, *khādi*, *jori* and *pasodi*, is made in every district where weaving is carried on to any considerable extent. Woven of the coarsest warp, occasionally home-spun, and with a weft of 20's or thereabouts, it is adapted only to rough use. When not bought for wrapping goods, it is sold only to the poorest classes for clothing and bed covers. Of the other kinds of cloth produced, it may be said that none are sufficiently in demand to give the industry any importance, were those already described to be no longer produced. The grey cloths from the looms are dyed and printed by hand, being thus adapted for use as bed sheets, floor cloths, &c.

The following description will convey an idea of the method of working up yarn into cloth in the Island of Bombay and in the neighbouring districts:—The Bombay weaver's loom is from 8 to 15 feet long by 42 inches broad. The weaver sits at one end with his feet in a pit about 2½ feet square. Immediately in front of him is a round beam which supports the warp and round which the fabric is rolled as it is woven. About a foot and a half in front of the beam is the reed or *phani* hung from the roof. Between the thin slips of the bamboo of the *phani* the warp threads are passed. This reed is set in a frame and forms the shuttle-beam, which, after the shuttle has passed, the weaver pulls back against the cloth beam to force home the threads of the weft. In the pit are the treadles or foot-boards. These in the case of plain cotton *sari*-weaving do not exceed two in number. In the case of silk-bordered *saris* they are four. The weaver generally keeps his left foot for the leftmost treadle and works the other with his right, raising and lowering the threads of the warp. The treadles are joined to the heddles by strings. The frames of the heddles are placed close behind the reed. The treadles generally correspond with the heddles in number. Over a loom with four heddles two cords, a foot or two long, hang from the roof. To the end of each cord is fastened one end of a cane or slender rod about 2 feet long which hangs vertically. To the lower end of the rod is tied a second cord about 6 inches long. The lower end of this cord is tied round the middle of a slip of bamboo about 6 inches long. From each end of this slip of bamboo, which lies at right angles with the cord, hangs another cord about 4 inches long. This cord holds by the middle a smaller slip of bamboo about 4 inches long. From each end of these small pieces of bamboo a cord 12 inches long passes, each of the four cords being fastened to the heddle frame about 4 inches inside of the edge of the warp. These cords move up and down with the motion given by the treadles. The heddle frame is filled with couples of loops of twine, interlaced, one fastened to the top and the other to the bottom of the heddle frame. Through the heddles all the threads of the warp pass, some through the upper and some through the lower loops. Some pass through a loop in the first heddle, while others pass between the loops of the first heddles and through loops in the other heddles also. The working of the treadle moves the heddle, and the heddle moves the threads of the warp which it governs, while between each movement of the warp threads the shuttle loaded with weft yarn is passed across the warp. Behind the heddles horizontal rods are thrust between the upper and the lower threads of the warp to keep them from entangling, and 10 or 12 feet further is the warping rod, round which the warp is wound. This rod, which is about 4 feet long and 2 inches thick, is tied to another rod known as the *turai*, kept tight by a rope passed round a post and brought back along the side of the loom, being finally fastened to a peg close to the

weaver's right. The weaver from time to time loosens the rope as the woven fabric is wound round the cloth beam. The shuttle is about 8 inches long and is made of buffalo horn. The bobbin holding the thread is fixed on one long pivot; in weaving, the shuttle is thrown by the hand through the shed of the warp alternately from one side to another. After it has passed one way the reed is brought up against the thread with a jerk, thus forming the woof.

Bombay weavers do not generally take the trouble to make their own yarn which can be obtained at easy prices from the mills. They can also obtain it of any colour they want, but in the rare cases when they want it coloured it is dyed before it is sized, either with German aniline dyes, or by steeping in the indigo vats of the local indigo dyers. The cotton yarn, first moistened by dipping it in water, is then thrown round the large reel. To reduce the size of the skein, it is wound from the large reel on to a middle-sized one. In re-winding the skein, the winder holds in his toes the end of the central rod of the larger reel and with his right hand draws off the yarn from the skein to wind it on a smaller reel which he holds in his left hand, whirling it in a smooth cocoanut cup. To reduce the skein to a convenient size, the yarn is wound off the middle-sized reel on to a small conical spindle. It is then taken to the wheelman, by whom it is wound round the bobbins. Next, to prepare the warp, women and children pass the yarn two threads at a time in and out among rows of bamboo rods about 4 feet apart. It is then spread on two bamboos stretched tight between two posts and sized with rice paste.

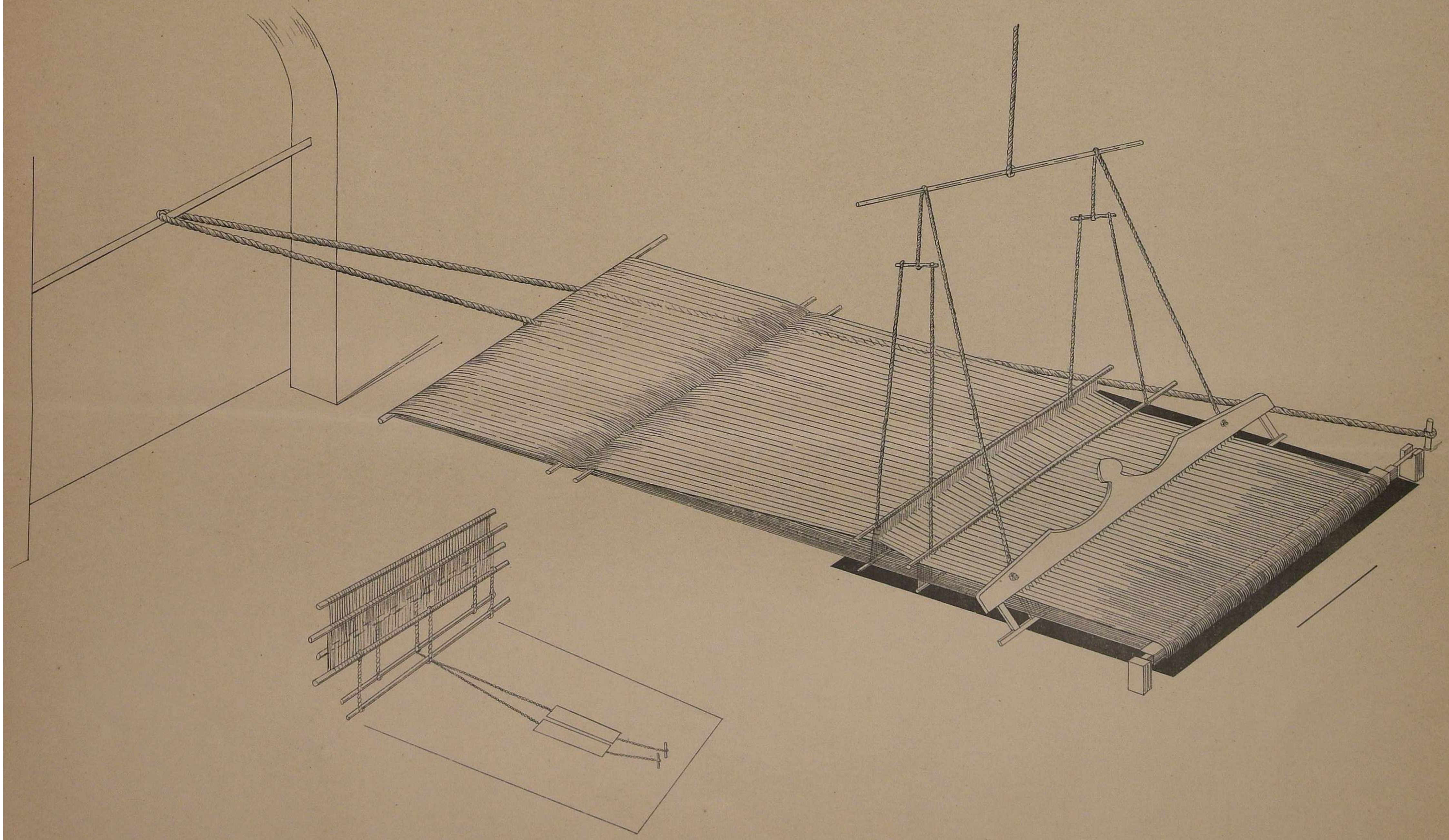
The warping machine consists of a pair of beams supported on a trestle of crossed sticks resting on the ground and made fast by a rope to a peg fixed in the ground. This arrangement is known as a *panjani*, and is a familiar sight in every town and village where weaving is carried on. The *panjani* is rigged up in the streets outside the weavers' houses, sometimes in the gutters or in an adjacent river bed. The length of thread between the beams is from 30 to 50 yards. The warping is usually done by the women and children of the weaver's family, who are to be seen working away in the streets morning and evening, while the weaver and his loom are hidden away in the interior of the dark and ill-ventilated houses.

The process of weaving cotton cloth in Sind is thus described:—The cotton is first carded, then spun and reeled. The reeled thread is kept in water for four days in order that it should become firm. At the end of the period the thread is taken out of water and dried without wringing it; when dry, the thread is divided into two parts, viz., the warp and the woof. The warp portion is wetted in *peji* (a decoction of rice water with an admixture of a little country oil) for about half an hour and then dried by suspending it on wooden posts, three on each side, fixed in the ground in an open space, after cleansing it with a *palat* (brush). When dry, the warp is ready for use. The woof portion of the thread is rolled by means of a spindle or spinning jenny, and is then ready for use. The warp is suspended on wooden posts in the whole of its length. The weaver then sets to work with a number of shuttles by his side. He seats himself in a pit up to his waist and keeps his feet on the *pagtharas* (wooden shoes), which are suspended by straps of leather or pieces of rope to the warp. The *pagtharas*, which are worked with the feet, are instrumental in keeping the two parts of the warp separate from each other. The *naro* (shuttle) with the woof portion of the thread rolled on it is then put in a *nariho* (long hollow iron case) and the latter is tossed from hand to hand to and fro between the upper and the lower parts of the warp. A *rach* and a *hatho* are previously put together and passed through the warp, and as each thread of the woof is put in they are struck against the part woven, in order to bring the weft threads together. As the work of weaving progresses, the artisan goes on turning his *tur* (beam) and the woven portion of the cloth is rolled on it.

In the case of hand-woven yarn used for weaving in Sind, the thread is first spun from cotton on the common spinning-wheel, and the rolls of the same are taken off the spindle. Each roll generally weighs about $1\frac{1}{4}$ tolas. These rolls are again unrolled on a wooden reeling wheel and formed into skeins of single thread. Generally each skein is composed of four rolls of thread and weighs about $1\frac{1}{4}$ sers or a little more. This is considered to be sufficient for one whole piece of common cloth or *jori*, which is usually 24 cubits in measure.

The thread is then opened and placed round pieces of reeds fixed in the ground, to the length of the whole web of the cloth, in such a way that it passes on the reeds inside and outside alternately. When the whole thread is thus unrolled, the reeds are taken out and pieces of thread are placed in their stead. This is the web or warp of the web for the future cloth, or *tani*, or *tanaji*, as it is called. The web is then soaked in water and left to dry. As soon as it is dry, the weavers go to an open piece of ground and fix two cross-posts in the ground at each end of the length of the warp, and the warp thread is then stretched on them. They then brush it with a big brush called *suwari* or *hathio*, in order to make it clean and to detach one thread from another. Then the pieces of thread alternately put for reeds throughout the warp are removed and replaced by thin pieces of sticks, generally of the tamarisk or bastard cypress, each about two feet in length. These pieces of sticks are called *itis*. When the warp thread is thus brushed and made clean, the whole is put in a large flat earthen vessel and wetted for four days in a sort of watergruel made of *jowári* or wheat flour. It is again stretched out on posts in its whole length and brushed as before. It is then ready for weaving.

Before commencing the work a square beam called *tur* is placed in front of the weaver, fixed in other pieces of wood at its sides, so that it can easily turn round as if on an axle. A rod (*gaz*) is then tied to the beam by means of threads, and between them are attached the ends of the warp on one side, in such a way that as the cloth is woven it is gradually rolled on the beam. A post is also fixed at each side of the web in the loom for supporting the warp bridge which is called *kharak*. A comb made of reed slips, fixed in a wooden frame with a handle to move it to and fro, is thrust in the warp thread. Two threads are passed through each space between the two teeth of the comb and one thread in the space left in each treadle. Then the work is commenced by passing the shuttle, which contains a roll of thread to supply the woof, and the cloth is woven by degrees.



12.—Cotton Fabrics of the Bombay Presidency.

Cloth Loom.

THE COTTON FABRICS OF ASSAM.

By H. F. SAMMAN, Esq., Sub-Divisional Officer of Chuadanga, Nadia.

In Assam, as in most other parts of India, cotton cloth is the chief material used by the people for their dress, their satchels, their bed sheets, and their rugs. From time immemorial the inhabitants of this Province have spun cotton thread and woven cotton cloth. The homespun thread and home-made cloth are now giving way before those imported from the West, but as yet they have not been entirely driven out. The cloth now woven is nearly all ornamented in greater or less degree; very little is absolutely plain. The fabrics and the ornamentations they display vary widely over the Province—the fabrics in texture, the ornamentations in design, and both in quality. One of the main causes of this wide variety is the immense mixture of tribes and races found within the Province.

Weaving among the Assamese forms part of a girl's education and part of a woman's ordinary household duties. The women of the family are expected to make their own clothes and those of the men as well. In former days they certainly did so, but now a change is coming over the country. Cotton fabrics imported from Europe and India can be purchased ready-made for a moderate sum, and these, though less lasting, are much finer in texture than those usually made by the Assamese. Accordingly, among the richer classes, the women have given up weaving cloths for ordinary wear and confine themselves to the production of fine cloths delicately and tastefully ornamented with borders and patterns of silk or gold and silver thread. The middle classes, too, have now taken to wearing imported clothes, and it is among them, at the present day, that weaving is at its lowest ebb. The poorer people, especially those living in the interior, still, to a large extent, make their own clothing, as they cannot afford to purchase foreign goods, and, in most cases, too, prefer their own productions.

While weaving as an art, a household duty or a pastime is looked upon with high respect, weaving as a means of livelihood is considered derogatory to almost every class of people (except in Mangaldai). It is only the Katonis, a low weaving class whose products are coarse and rough, and the hill tribesmen settled in the plains, who make cloths for sale and take them to the market. A few old Brahmin widows who have no relations to support them and no other means of livelihood, are driven by dire necessity to sell the cloths they weave in order to eke out a bare subsistence, but even they dispose of their goods as privately as possible.

Such is the nature of the industry in Assam Proper the districts of the Brahmaputra Valley. Among the hill tribesmen weaving occupies much the same position. As the Deputy Commissioner of the Garo Hills remarks, weaving is hardly more of a profession than cooking. Here, however, there is not the same feeling against earning an honest penny by the sale of home-made cloths. Whatever surplus there is in the family is either disposed of to a neighbour or some member of an adjacent tribe, or else taken to the nearest *hât* and sold or bartered for the necessaries or luxuries in demand. With the exception of the Hill Miris and possibly the Akas, all the hill tribesmen are acquainted with the art of weaving, though some are very backward in it. Among them all it is the women who spin and weave; the men have no knowledge of the processes.

In the Surma Valley the nature of the industry is entirely different. Weaving among the plains-people of this valley never was a household industry, but was confined only to the Tantis and Jugis (or Naths), professional weaving castes. Among the Tantis men and boys only, and among the Jugis both men and women engaged themselves in weaving; but among all other classes, except the hill tribesmen, the occupation was considered derogatory for men and women alike. The finer cloths were woven by the Tantis and the coarser by the Jugis. The nature of the industry is the same now as it always has been, but the industry itself has become almost extinct even among the professional weaving castes, who have been driven to agriculture and other occupations now that their own has been rendered unprofitable by the influx of cheap imports from abroad.

To sum up, the cotton weaving industry in Assam is, at the present time, in three distinct stages among the different classes of the people. Among the civilized inhabitants of the Surma Valley the industry may be said to be extinct, and there is little probability of its revival, unless mills be established. There seems no particular reason why cotton mills in Cachar or Sylhet should not be a profitable venture, as the cotton is grown so near at hand, and with the opening up of the country by the railway, cheap labour should be easily procurable. Among the Assamese proper weaving still holds an important position, even in the manufacture of the coarser cloths. It will probably be long before these are altogether superseded by imported fabrics, and the weaving of delicately ornamented cloths will, no doubt, long continue to be a favourite pastime for the wives and daughters of the well-to-do. In the hills also and among the hillsmen who have settled in the plains, weaving is largely practised. But here the industry is rapidly declining, and there is little doubt that its decline will continue. The rough hillsman does not, like the Assamese, disdain to labour on the soil at a daily wage. More and more every year are resorting to the tea gardens, where both men and women can earn a wage far in excess of what they could possibly earn by the most assiduous application to the loom. Others, though not caring to work on the gardens, are turning to agriculture, which they find a more profitable occupation, and buying their scanty clothing from the bazár.

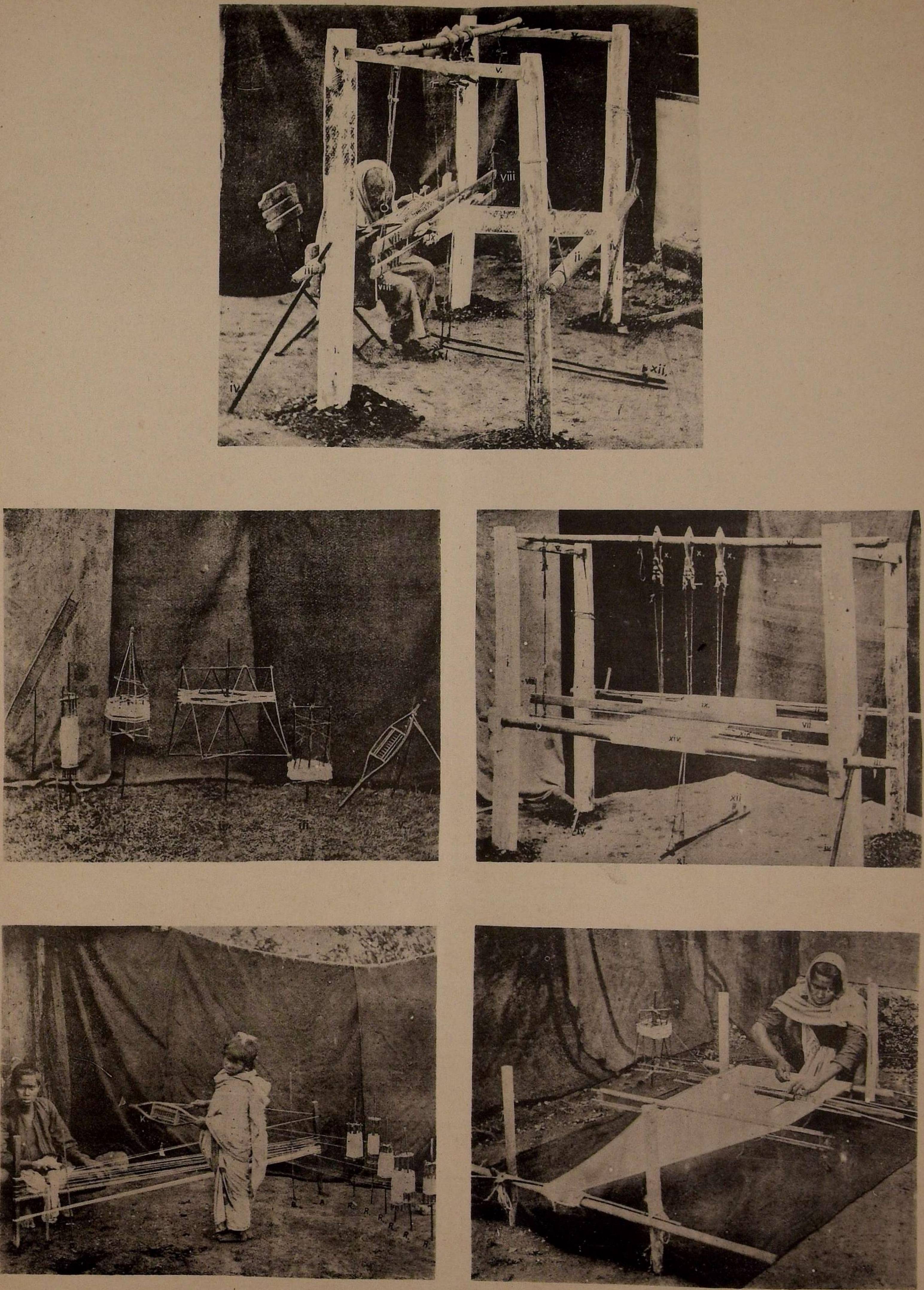
The Process of Manufacture.—The process of manufacture followed in the plains is much more complicated than that used in the hills; but either process is extremely simple compared with those of the West. There is no need to compare the simple instruments made in Assam with the complicated machinery of the English mills, but it may be well to notice some essential differences. In the first place, the cotton usually reaches the mills in England not in its raw state, but with the seed extracted; in any case, the gin is never in the same building as the spinning mills. Thus the process of ginning is hardly considered a part of the spinning and weaving industry. On the other hand, the cotton generally arrives in bales packed by machinery, and in consequence the loosening of the fibre and cleansing it from all impurities form very essential portions of the manufacture and require very careful attention. In Assam the cotton is either raised by the very men who convert it into cloth, or else is brought down from the hills, packed in baskets by hand, and sold to these men in small quantities. There is, therefore, practically no loosening to be done and cleaning is a simple matter, but ginning is an essential branch of the manufacture.

Cleaning raw cotton : The first step in the cleaning of cotton in Assam is to free it from all the impurities with which it has got mixed on the tree while being gathered, or on its journey from the tree to the market. The earthy and vegetable matter thus accumulated is picked out as far as possible by hand. This stage of the process is often dispensed with. The cotton is next spread out in sieves, and exposed to the sun for three or four hours to dry. It is never dispensed with, as it is absolutely necessary to ensure a good outturn when the cotton is ginned. The sieve is of bamboo and can be made by any Assamese. The cotton is now ready to be ginned, unless it be required for making very fine thread, when it is first combed with a comb made of the teeth or rather jawbone of the *borali* fish ; this combing effects a double purpose by removing not only the minor impurities left in after the preliminary cleaning, but also the loose and coarser fibres of the cotton. The next stage in the process of cleaning is ginning, *i.e.*, the separation of the seeds from the fibre, which is performed by means of the gin, which consists of two horizontal rollers, one close above the other, mounted on an upright stand.

Spinning : At the end of the cleaning process the loose fibres of cotton are gathered up and taken to an enclosure surrounded and roofed with bamboo mats, and there the cotton is bowed. The object of this mat-house is to prevent the fluff from flying about. The bow consists of a single piece of bamboo about three feet long, and rather wider in the centre than at the ends ; to which is attached a string made either of a very fine strip of cane or of the midrib of a plantain leaf. To use the bow a mass of cotton is thrown on a mat or the bare ground, and the handle of the bow is held in the left hand in such a position that the string almost touches the loose mass. The string is then pulled by the fingers of the right hand into the mass of cotton and let go. The vibration throws the cotton in all directions and loosens the fibres. A sufficient quantity of cotton having been thus bowed, it is picked up and placed in small handfuls on a smooth wooden stool or on a flat piece of wood with a smooth surface. The operator then places a small slip of bamboo or ekra on a handful of cotton, and rolls it with the open hand over the cotton, which is picked up and wound round the slip. This roll of cotton is then slipped off the slip and is ready for the spinning-wheel. The next stage in the process of spinning is the conversion of these rolls of cotton into thread by means of the spinning-wheel. To work this machine the woman sits facing it, and with her right hand turns the handle, while with her left hand she takes up one of the rolls of cotton and applies the end of it to the point of the spindle nearest to her. The rotary motion of the wheel is communicated to the spindle by means of the connecting cord, and each revolution of the former produces 8 to 12 revolutions of the latter owing to the difference in their diameters. The rapid revolution of the spindle causes its point to pick up a fragment of the roll of cotton applied to it, and as the woman raises her left hand to its full length a thread is drawn out. A slight change in the direction of the extended arm causes this thread to roll up round the spindle, the roll being meanwhile gradually brought down to the spindle point. The same motion of the arm is then repeated till the whole roll is converted into thread, when another roll is taken up and treated in the same way. When the spindle is full the balls of thread are slipped off and are ready for the next process, viz., weaving. The thread thus spun is not often of very good quality. Its thickness and evenness depend on the way in which the roll of cotton is manipulated by the operator. If this be pressed tightly between the finger and thumb and the tension of the thread be kept firm and uniform, the result will be a fine and even thread ; if the roll be loosely held, a coarse thread is the result.

In the case of home-spun thread, when the process of spinning has been completed, the thread is left in the form of balls, each having a hole through the centre. One of these balls is taken up and a spindle (detached from the spinning-wheel) passed through the hole. The thread is then wound off the spindle on to a reel. The skeins thus formed are next boiled together in an earthen pot with some rice or paddy. When the latter has been thoroughly boiled, both it and the thread are taken out of the water and the rice or paddy pounded in a paddy-husking machine until it is reduced to a glutinous paste or starch. The skeins are then smeared over with the whole of this paste, and in that state again boiled, after which they are taken out of the water, and slipped over a reel so formed as to allow of the framework revolving round the central rod. From this reel the thread, while still wet, is wound off again on to the first reel, from which the skein is taken off and put on a bamboo rail in the sun to dry.

Weaving.—The weaver takes her seat in front of the cloth-beam, facing the loom. Within easy reach lies the shuttle with a full spool of thread ; a supply of more spools is kept on the ground beside her either in a cane basket or more usually in an earthen pot containing a little water to keep the spools damp. A yard stick is also generally at hand for making any necessary measurements ; and hanging from the cross-rod above is a little cane basket containing spare lengths of threads to repair breakages. Thus equipped, the weaver commences work. Pressing one treadle with her foot, she raises one shaft of healds and lowers the other, thus making a gap between the upper and lower threads of the warp, and throwing the intersection against the cloth-beam. Through this gap she throws the shuttle with its spool of thread, say, from left to right, holding the loose end of thread on the left of the warp. This end is never fastened or woven in, being simply cut off when the cloth is finished. A thread has thus been shot between the upper and lower threads of the warp, and in front of the intersection. The weaver now pulls the reed towards her and drives home this thread. She then presses the other treadle; thus making a fresh gap between the warp threads, but the position of these threads has been interchanged, *i.e.*, those which were originally above are now below and *vice versâ*. There are, therefore, now two fresh intersections between them, and as the threads are kept at tension by the healds, these intersections lie at their two extremities. Another thread of the weft is then shot and driven home with the reed, the shuttle having been thrown from right to left. Thus the intersection at the weaver's end is woven in. A second pressure of the first treadle again reverses the position of the threads and brings the remaining intersection from the far end and throws it against the weft thread just shot. The position now is, therefore, exactly the same as when the weaving was commenced. Another weft is shot from left to right and the weaving is continued, the same process being repeated again and again.



13.—COTTON FABRICS OF ASSAM.

Looms and Reels.

COTTON FABRICS OF THE NORTH-WESTERN PROVINCES AND OUDH.

By CHAS. A. SILBERRAD, Esq., B.A., B.Sc., I.C.S.

The only kind of cotton grown in these Provinces which is of commercial importance is the short-stapled variety known as "Bengals"; this includes various kinds known to botanists as *Gossypium herbaceum*. These Provinces, as regards cotton-growing, may be divided into two parts. The first, including Oudh and the North-Western Provinces east and north-east of Allahabad, grows little cotton, the quantity diminishing as one proceeds east. Here production, as a rule, is insufficient to meet local demands. The second includes the remainder of the North-Western Provinces. The most important cotton-growing districts are those of the Jumna-Ganges Doáb and Bundelkhand. Here exports largely exceed local consumption. Cotton cultivation extends but a short distance up the slopes of the Himálayas, a little only being grown in the southern portions of Garhwál, Naini Tal and Almora. The total area under cotton varies about 1½ million acres, generally rather exceeding that amount, while the outturn probably lies between 750,000 and 1,000,000 cwts. Of this amount approximately three-fourths are exported; the remainder is used locally, about one-third probably being employed for quilting purposes and the remainder spun. But that which is used for quilting ultimately to a considerable extent is spun, the cotton being removed after the quilted article is worn out; the extent to which this is done varies with the price of the fresh cotton.

Ginning.—Cotton is always picked before noon, so that the bolls shall be still damp from the dew, and so come away easily without much admixture of "leaf." The cotton so picked is termed *kapás* and is rarely ginned by the grower. He generally sells it as such to a *bania* at some large village, who has it ginned. For ginning there is but one instrument in use throughout the Provinces. The essential parts of the instrument are the two rollers, one of which is usually of iron; the other (the lower one) is of wood. These are geared together by an endless screw, so that when the wooden roller is turned by the handle the iron roller rotates also. The rollers are fitted into two wooden uprights 18 inches to two feet in length, inserted into a flat piece of wood forming the base of the machine. To secure greater stability, a piece of wood is fixed at right angles to the base. There is usually a piece of cloth fixed to the two uprights so as to hang down below the rollers to the wooden base of the machine. The worker turns the handle with one hand and presses seed cotton between the two rollers, which are so fixed as to press moderately tightly against each other. The floss is thus caught between them and dragged off the seeds, which fall down on the side on which is the worker; while the floss passes through and falls on the opposite side, seeds and floss being prevented from mixing by the cloth above mentioned.

Cotton Cleaning.—After being ginned, cotton intended for export is taken to the nearest cotton press, of which there are many in these Provinces, there made into bales, and then despatched to where required. That intended for local consumption requires to be opened up, cleaned and made into a form ready for spinning. The preliminary processes in the mill-industry are "opening," "scutching," "carding," "combing," "drawing," "slubbing," and "roving." In the hand industry the preliminary operations result in the production of a sliver (termed *púni*), corresponding closely to the state of the material after being carded in the mill industry. All the subsequent processes, which result in attenuating the sliver and imparting a slight twist thereto, are performed by the spinner at the same time as he does the actual spinning. The ginned cotton is, as a rule, first roughly picked over by hand, usually by the person who will spin it, or by some members of the family. It is then handed over to the professional cleaner to undergo the process termed *dhunna* or in the hills *phatakna* or *phánna*. The basis of all methods is one and the same, viz., to cause a tightly-stretched string to vibrate in a heap of cotton; the vibrating string separates and opens the matted masses of floss as pulled off the seeds in ginning, thereby greatly increasing the bulk and shaking out dust, dirt and other impurities, which gradually settle down to the bottom of the heap.

Spinning.—The wheel is termed *charkha*, *rahta* or *phirka*, and consists ultimately only of a mechanism whereby the spindle or sharp pointed thin iron rod can be rotated at a high speed. This is effected by connecting the spindle by an endless string with a large wheel. To spin, the operator—usually a woman—squats with the wheel in front of her and the driving wheel on her right hand, with which she turns it; the projecting end of the spindle is thus towards her and on her left; she then takes a *púni* and draws out a little of the cotton at one end and twists it by hand, so as to make about four inches of truly handspun yarn (which is left attached to the remainder of the *púni*). The yarn is made to adhere to the spindle, and the spinning proper commences. The spindle is caused to rotate very rapidly, and at the same time the left hand is drawn up so as to reach about two feet from the point of the spindle; the fingers simultaneously pushing out a little of the cotton of the *púni*, the rapidly rotating spindle twists the cotton as it is drawn out, thereby producing yarn. When sufficient twist has been imparted, the spindle is rotated slowly and the yarn allowed to coil itself on the projecting part of the spindle behind the point. To prevent the spun yarn working backwards and becoming entangled with the bearings of the spindle, a leather stop is sometimes put on the latter. The process thus continues till the whole *púni* is spun, when a new one is taken and a little yarn spun from the end, but instead of being caused to adhere to the spindle it is twisted into the end of the yarn already spun. The yarn so wound on the spindle forms a double cone truncated at one end if a *dhibri* is used; this is known as a *kúkri*, and is then wound into skeins by aid of an *ateran* or of a *paraita*. The latter is, however, more often used as a support for the hank, when it is to be wound on to the *nalis*, the small reels used in laying the warp.

Warping.—The next process is to lay a sufficient number and length of threads of yarn parallel to form the warp of the fabric to be woven. The yarn, whether hand-spun or machine-made, is usually obtained by the weaver in the form of skeins or hanks. They are soaked in water for 24 to 48 hours and then wound on to suitable sized reels. To do this the skein is supported either on the *paraita* or on an instrument serving the same purpose, termed *pari* or *charkha*. The skein is wound off these on to the reels by turning the spinning-wheel, the wheels being replaced by others as they get filled. The warp is first laid on an arrangement of sticks termed *pariya*. Four stout sticks are firmly put in the ground. Two rows of light straight sticks, 2½ to 3 feet long, are placed in sets of four; all four are stuck in the ground as close together as possible, but diverging at the top so as to form

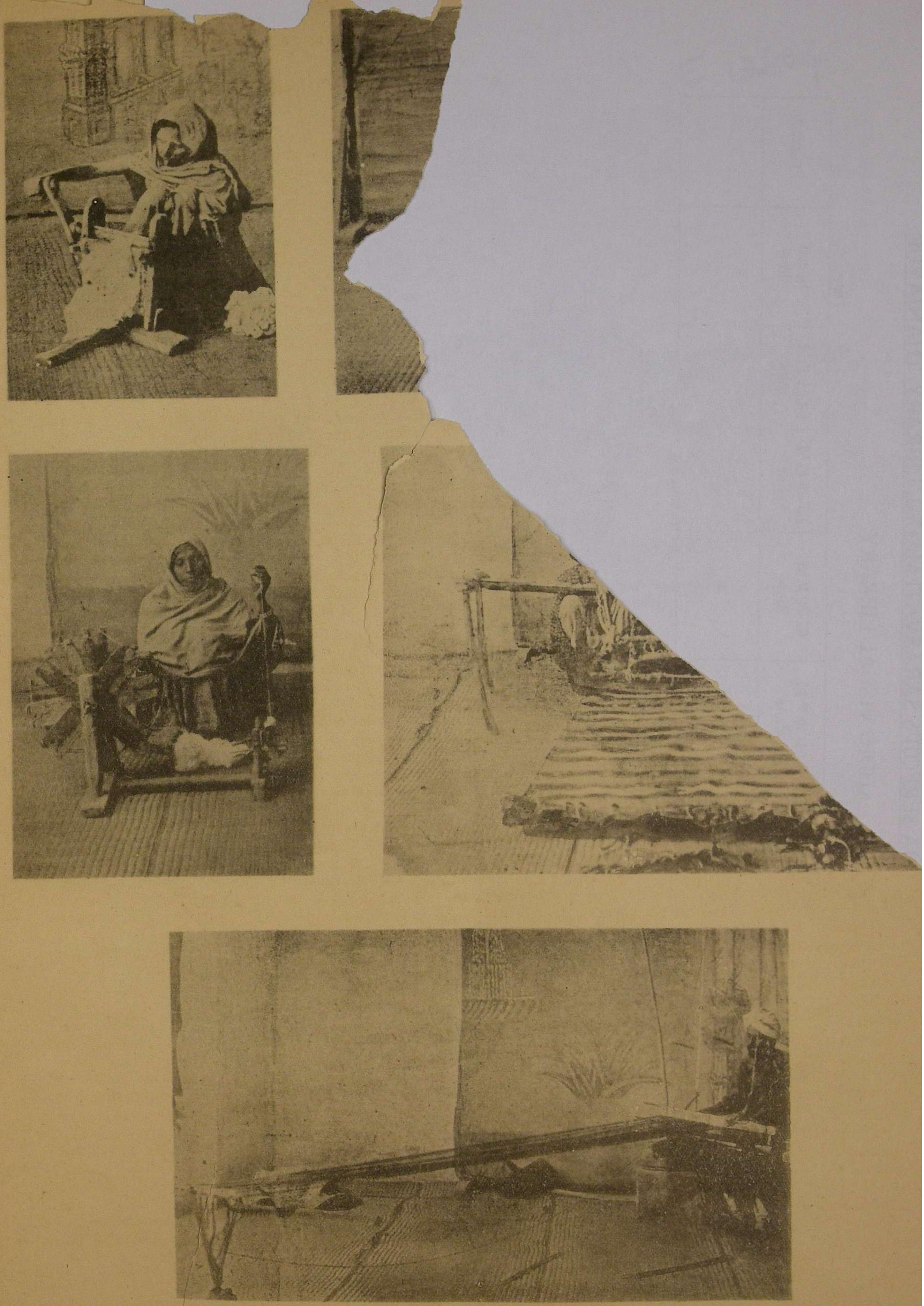
the corners of a square, each side of which is about 10 inches. The distance between each successive set is three to four feet. A large reel of yarn is slipped on an iron nail, some 8 or 9 inches long, with a head sufficiently large to prevent the reel falling off. This nail is inserted head downwards into a hollow stick about two feet long, in which it is kept by friction. The warper takes two of these in his two hands, and beginning from the large stick at the end of one of the rows lays the yarn round the lighter sticks, going outside the first and inside the next, repeating this till the end of the second row is reached, when he returns, this time laying the yarn the reverse side of the sticks. The yarn is supported by the tension and the friction against the sticks, against which it presses by reason of its being placed alternately one side and then the other, besides being supported by the slant at which they are. The warper continues the process till a sufficient number of warp threads for the breadth of cloth to be woven is laid. The result of the arrangement is to produce a cross between every pair of sticks whereby each successive thread is kept separate throughout its length, and to prevent successive threads from getting mutually entangled. After sufficient warp is laid, a thin bamboo of a length slightly greater than the breadth of the cloth to be woven is inserted just one side of each set of four sticks, so that it slides between the two layers of warp. Its two ends are united by a piece of yarn; this maintains the crossed arrangement of the warp threads when the sticks are removed. This now follows, but the large sticks are left at the ends, and the whole rolled up and starched by immersing in starch water.

The warp is then stretched horizontally on another system of sticks known as the *mánjhá.* This consists merely of a series of pairs of sticks stuck in the ground so as to form a letter X at such intervals as are needed to support the warp; the upper ends of the pairs of sticks are united by rope, while the warp is kept taut by attaching the stout sticks at the two ends to pegs firmly fixed in the ground. The warp threads are kept apart to a proper breadth by the bows inserted as before described. The starched warp is put on this arrangement and brushed longitudinally with a large brush made of *khaskas* (the roots of the *gandal* grass), or sometimes of cocoa-nut fibres. It much resembles an English carpet broom, but without the long handle. After the starch has dried the brush is usually oiled with oil of mustard. This operation smooths the yarn, causing loose ends to adhere to the main thread; at the same time any broken ends are mended by twisting the ends together. Lastly, the bamboo sticks which have so far separated the two layers of warp are replaced by stout yarn only, which is tied tightly so that the warp appears merely as a thick and long skein. It is all rolled or twisted about one of the stout sticks still remaining at the ends, and thus kept till required to be put on the loom.

Weaving.—There is practically but one form of loom in use throughout these Provinces. The whole arrangement is always under cover and raised but a few inches above the level of the ground: consequently to enable the weaver to sit at his work a hole is excavated some 18 inches deep, wherein he sits, so that the beam is immediately above his thighs. The process of laying the warp as described results in an endless warp, each thread of it turning over the stick at the extremity, and continuing as the corresponding under-thread. The warp threads are now all cut at this extremity and one by one passed through the appropriate loops in the heddles and space in the "lay," and firmly attached to the beam. As this is a very tedious process, it is usual to do it once and for all; a sufficient length of warp thread is left unwoven to pass through the heddles and *ráchh,* and the new warp simply attached to the old, each thread being twisted (not knotted) on to the old warp. It is obvious that so long as the same arrangement of heddles is adhered to and the same breadth of cloth woven, no change is required. In fact, many weavers have *ráchh* and heddles with a small strip of woven cloth and warp passed through them which have been in use from their fathers' times. This is specially the case with the choicer patterns. At Sahâranpur I was shown such an arrangement containing 16 heddles which none of the weavers then living knew how to use. The whole length of warp spread out horizontally is from two to four yards, according to the space available. The warp is kept stretched properly by an arrangement known as *bhanjhní,* consisting of three smooth and stout bamboos placed above and below the warp and tightly bound together, so that the threads cannot slip between them. To the ends of this are attached two cords, which join, whence a single rope passes over one or more pegs, and is attached to the peg which is within easy reach of the weaver's right hand. As weaving proceeds and more warp is required he loosens the rope and winds the woven cloth on to the beam. The remainder of the warp not yet stretched horizontally between the beam and the *bhanjhni* is hung loosely over a bamboo. It will be remembered that in the warp, after the final brushing, the bamboos which kept the crossings of the successive threads intact were replaced by ties of thread. When stretched on the loom these ties are again replaced by sticks, of which several varieties are used.

The shuttle is usually made of sheet iron and is very similar to the old shuttle used in Europe. In shape it is like a canoe, the similarity being increased by the way the two ends are covered in. Along the centre is a thin iron pin which can be lifted up at will. On to this the *nari,* on which the weft yarn (which is always moistened before weaving) has been wound, is slipped and fastened down. As each fresh *nari* is put into the shuttle the iron pin is oiled, for which purpose the weaver generally places an oil lamp near his right hand.

After the warp has been spread on the loom and all the instruments used made ready, weaving begins. The appropriate heddle is depressed, and the shuttle passed from one side to the other between the warp threads so depressed and those left above. The weft thread so put in is driven into the proper position by the lay (*hátha*), and the other heddle depressed, the shuttle passed back, and the process continued. When weft stripes are required, yarn of the appropriate colour is inserted in the spindle and the required number of weft threads of this colour is inserted. As a rule, when this is done several shuttles are used. The dimensions of the loom and of its adjuncts vary with the breadth of the cloth to be woven, but it is rare to find a loom capable of weaving cloth much over three feet in breadth.



14.—Cotton Fabrics of the North-Western Provinces and Oudh.
Spinning, Weaving, &c.

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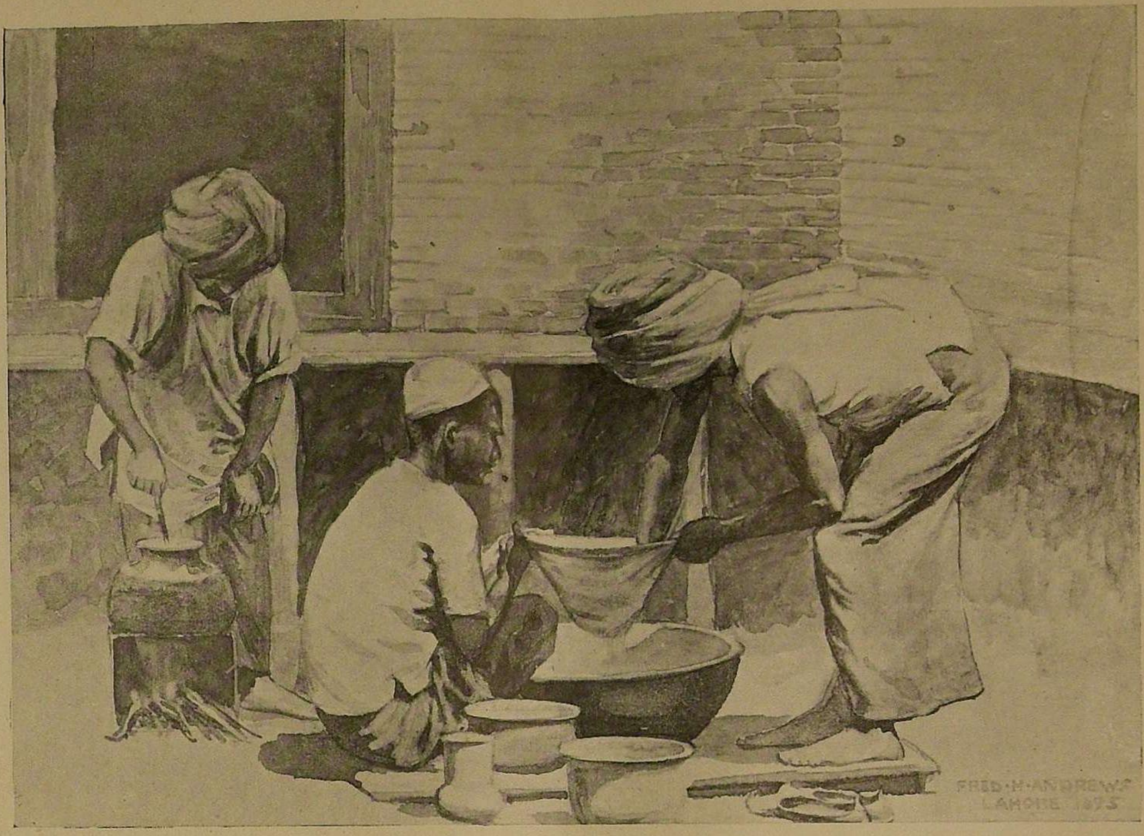
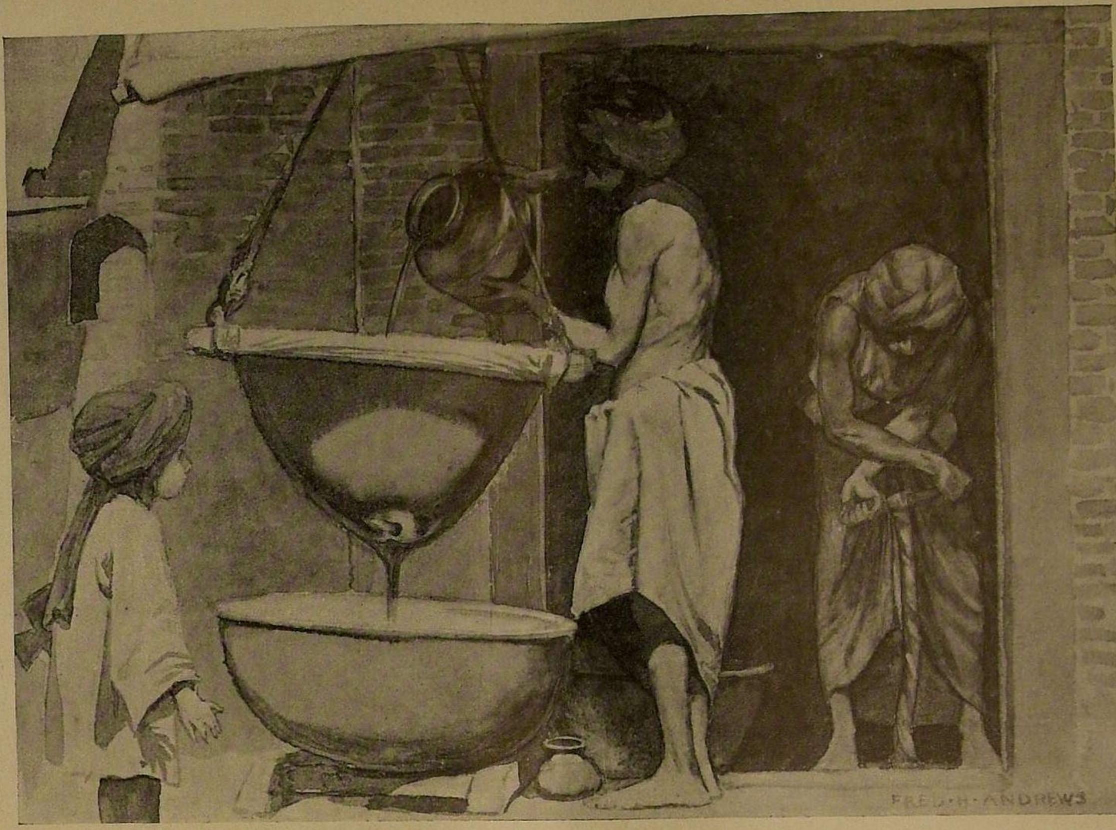


Preparing rice-starch.

14*a*.—Dyeing in the N.W. Provinces.

Starching.

(*From drawings by Mr. Fred. H. Andrews, Lahore*).



Straining Dye.

14*b*.—Dyeing in the N.W. Provinces.

Cotton Printing.

(*From drawings by Mr. Fred. H. Andrews, Lahore*).

14c.—Dyeing in the N.W. Provinces.

Dyeing.

(*From a drawing by Mr. Fred. H. Andrews, Lahore*).

SILK IN BURMA.

By J. P. HARDIMAN, Esq., I.C.S., Assistant Commissioner.

There is no mention in authentic historical record or local legend of the source from which the silk industry was brought into Burma, of the channel which it followed, or of the manner or date of its introduction. There is a similar silence concerning the introduction of silk into India generally. The weight of opinion favours China as the fountain country. Philologists point out that the equivalents in other languages of the Chinese *szu* (silk) are phonetically allied to that form, and quote *sericon* (Gk.), *sericum* (Lat.), *soie* (Fr.), silk (Eng.) and others. Even the classical name of the country (*Seres*) is said to be derived from the *szu* which was its chief product, though the lay reader might suggest that it is equally probable that the product was named from the country.

Perhaps a safer basis to take in reviewing the question of the birthplace of the silkworm is a consideration of the habitat of those forms of food which are most congenial to it. Building on this foundation Hutton holds that all forms of the domesticated mulberry-feeding insect came from the north-western tract of China, where a temperate climate favoured their development, and thence spread later to India, where they are purely exotic.

Neglecting varieties which are not reared in large quantities, it may be said that the silk crop of Europe is got from a worm which thrives in a temperate climate, requires cold for the hatching of its eggs, and produces but one crop of cocoons in the year; these cocoons, however, contain a large amount of silk, which can be easily reeled. In Burma and in India generally, on the contrary, the silk crop is produced by smaller varieties, which thrive in sub-tropical climates, do not require cold for the hatching of their eggs, and produce each year several crops of cocoons: these contain a comparatively small amount of silk, in quality perhaps equal to that produced by the European worm, but so loosely wound upon the cocoon that it is almost impossible in reeling it off to prevent entanglement and thus to produce a thread equal in value to the thread easily obtained from the European variety. For facility of classification the whole body of silk-producing worms is divided into two classes:—(1) Domesticated or mulberry-feeding; (2) Wild or non-mulberry-feeding, feeding for the most part on the leaves of trees and plants that grow within the jungle. The term "wild" is used more in a commercial than a literal sense, for many of the second class, though they do not feed on the mulberry, yet, like the *tusser*, have been for many centuries domesticated in India and China. In Burma each of these classes is exemplified, but three species only are of importance enough to demand detailed consideration. These are, of (1) the *Bombyx Arracanensis*, or *Ngapaw*; and of (2) the *Cricula Trifenestrata* and the *Attacus Atlas*. The *Bombyx Arracanensis*, one of the numerous sub-species of the *Bombyx Mori*, the source of the silk of commerce, is a multivoltine silkworm, or one which goes through many generations in the year, and it may be doubtfully regarded as distinct from the *desi* and *Madrassi* races of Bengal. It is the peculiar form bred in Burma and hence got its specific name, which was assigned by Captain Hutton. It is said to have been introduced from China.

Of the *Cricula Trifenestrata* Manuel furnished the following account in 1884:—"Among domesticated or wild silk spinners, although a number are to be met with in all three divisions of the Province, the most notorious and the most extensively spread is the *Cricula fenestrata* or mango silkworm, called by the natives the *thayetpo* because it is usually met with on the mango or *thayet* tree." The worm is multivoltine, working all the year round, though most extensively and vigorously during the rains. The cycle of its existence is from 55 to 62 days.

The *Attacus Atlas, Linn.*—This moth is well known on account of its great size, some of the specimens in the Indian Museum being more than ten inches across from tip to tip of wings. According to Manuel, the insect spins once a year in its natural state, though in domestication in Burma it will spin twice or even three times—once at the commencement of the rains, once during the rains and again at the close of the rains, the best cocoons being those formed towards the beginning of the cold weather. The cycle of its existence is from 81 days to 8 or 9 months.

Reeling.—"After the cocoons have matured and before the exit of the moths they are prepared for reeling. Torn away from the cocooning trays by handfuls, they are thrown into baskets, and then the women and children of the family divest the pods of all their waste or floss. Then, without sorting or selection of any kind, except that the yellow and white pods are kept apart, the cocoons are put into a *chattie*, or earthen pot of water, and slowly simmered over a fire. The reeler (generally a woman who makes it her sole business to reel silk) tries the pods after they have simmered for a while, and as soon as she finds the fibre come away easily she picks up a handful of cocoons, each by a thread of silk,—the number usually being from eighteen to twenty-five—shakes them well to a sufficient length, and then runs them through a loop of brass wire on to a reel fixed to a pair of cross sticks of bamboo. From the reel the filaments are given a slight twist and carried on to a cylinder of wood with a handle and turning on a trestle. One woman manages the whole operation. She sits beside the fire, opposite the pot, over which the cross sticks with the loop and reel are supported. In her right hand she holds an iron fork, with which she regulates the outcome of the threads from the pot, and with her left she turns the handle of the cylinder of wood, on which the silk is reeled. Some practice is necessary to attend to and carry out operations with both hands so as to produce a tolerably even and fine thread, and good reelers generally command good wages, so that it is difficult to get one to leave her home. As much silk having been obtained from the cocoons as is possible, the pods are then taken out of the pot and whilst still moist and warm are stretched into a kind of coarse knobby thread, which finds a sale in the markets for coarse work."

Winding and Spinning.—The weaver places the raw silk over the winding machine, which is roughly constructed to receive the huge coil as purchased. From this the raw silk thread is unwound and passed over a large reel. The person manipulating the wheel feels the thread as it passes on to the reel, and cuts it off when a skein of different texture is reached, winding the silk thus on separate reels for the medium, the coarse and the fine. The medium threads are used for the warp, and the coarse and fine for the shuttle. The large reel is taken off its frame and hung up, and one end of the thread being wound round the reed-reel or spool, the spinning wheel is set in motion. All the raw silk thread is thus transferred in certain lengths to the reed-reels or spools, and when all

the thread has been thus removed the reed-reels are placed in a basket and the threads are then twisted into singles in the combined machine. The process is as follows :—The spools, usually eight in number, are fixed on to eight iron spindles attached to a large *yit* or spinning wheel. This has two wheels; that on the left has four strings passing round it. These strings in turn pass round each row of spindles placed one above the other, and thus each turn of the wheel revolves the spindles simultaneously. Each line of thread from each spool passes through an eyelet placed about twenty inches away from the quill-stand on to an eyelet on the main stand. The thread finally makes a skein round the reel fixed above the spinning-wheel and revolved by the motion of that wheel. The spinner holds the threads in the palm of his hand between the two rows of eyelets in order to make the skeins round the top wheel tight and to prevent the skeins intermingling. To loosen the skeins of spun silk and to facilitate their removal from the reel, a movable wedge is fixed in it. This increases the circumference of the reel, so that when the wedge is removed the skeins are loosened.

Cleansing and Dyeing.—After the silk has been twisted into skeins, four measures of soap sand are mixed with water and the mixture is put to stand for a night. The heavier ingredients settle at the bottom and leave the soapy water on the top. This is then poured into an iron cauldron or earthen pot and placed over a furnace. When the water reaches the bubbling point, the twisted silk in skeins of about fifty threads is put into the hoop of a bent cane or *gauk*, which serves as a handle. The skeins are plunged into the water and kept there till they become coarse to the touch. They are then taken from the pot and the water is squeezed out by holding the *gauk* with one hand and with the other hand forcing a piece of stick into the other end of the skein. The skein is then cooled and washed in cold water four times to bleach it. The water is wrung out and the silk is dried for a day. The white silk has by this time become pure white, and the yellow silk pale yellow. Imported aniline dyes are now taking the place of the old vegetable products. Dyes of different colours in powders or cakes, put up in paper packets or in tins, are procurable in most bazaars. There is no doubt that the old methods will, except in out-of-the-way places, soon be entirely abandoned and the less troublesome prepared dyes of the market used.

Weaving.—The loom (or *yekkansin*) consists of a frame with four small perpendicular posts, forming a rectangle measuring about four cubits by two-and-a-half. These are connected by bars at the top, in the middle, and at the bottom, a few inches from the ground. On the near, middle, and farther top side of the longitudinal bars rests a pair of rollers (*leik*) at the full distance of the length between the middle latitudinal bars. The roller at the nearer side, where the operator's seat is, is employed for rolling the finished fabric. On the other roller opposite are the threads which form the warp. To separate the threads of the warp into the alternately upper and lower rows, so as to allow of the shuttles being passed between them to make the web, are two comb-like frames (*hnat*), closed by a bar at the points of the teeth. Stout cotton threads form the teeth of the closed comb. These combs are hung at their respective ends by sliding looped cords resting on a round bar, usually a piece of bamboo placed across the top longitudinal bars of the main frame. Beneath the knot is a latitudinal cross-bar on which are placed two pedals (*che-nin*) for the feet of the operator; the toe-ends of these are connected by cords with the combs, to enable the weaver to alternate the two series of threads of the warp by alternately pressing the pedals with his feet.

Placed in front of the combs and nearer to the weaver is a third frame (the *lek-khat* or *yinthwa*), like the combs, but with twice as many spaces as each *hnat* has, to permit of all the threads of the warp being passed through the interstices; these are made of very fine slit bamboos. This third frame, which is employed for pressing the threads of the weft close together, is suspended at its ends by cords made fast to an independent cross-bar placed over the two top longitudinal bars of the main frame. Finally, there is the shuttle (*lun*), the body of which is made of hard black wood (*yindaik*), or, if large and for white fabrics and fabrics of simple patterns, of the almost equally hard red wood (*padauk*). The spindle is manufactured out of hard bamboo. A hundred of the former cost three rupees and one of the latter costs four annas. An entire weaving frame with all appurtenances costs about ten rupees.

The preparation for work is as follows :—The threads for the warp where the weaver sits are looped on to the roller (*leik*), and after passing through the interstices of the pressing comb (*lek-khat* or *yinthwa*), pass alternately through the lifting and depressing combs (*hnat*), then from under the farther roller (*leik*), round it, and over the top of the cross-bar and roller at the farther top part of the frame, till they reach the top bar above the weaver's head, where they are gathered into a bunch and secured to a piece of wood made fast to the top bar overhead, to allow of the worker paying out the warp thread as the fabric grows and is rolled up on the roller in front of him. The seat is a rough bench, usually made of a movable plank, with two holes let into projecting parts of two upright posts fixed into the ground.

LIST OF ILLUSTRATIONS.

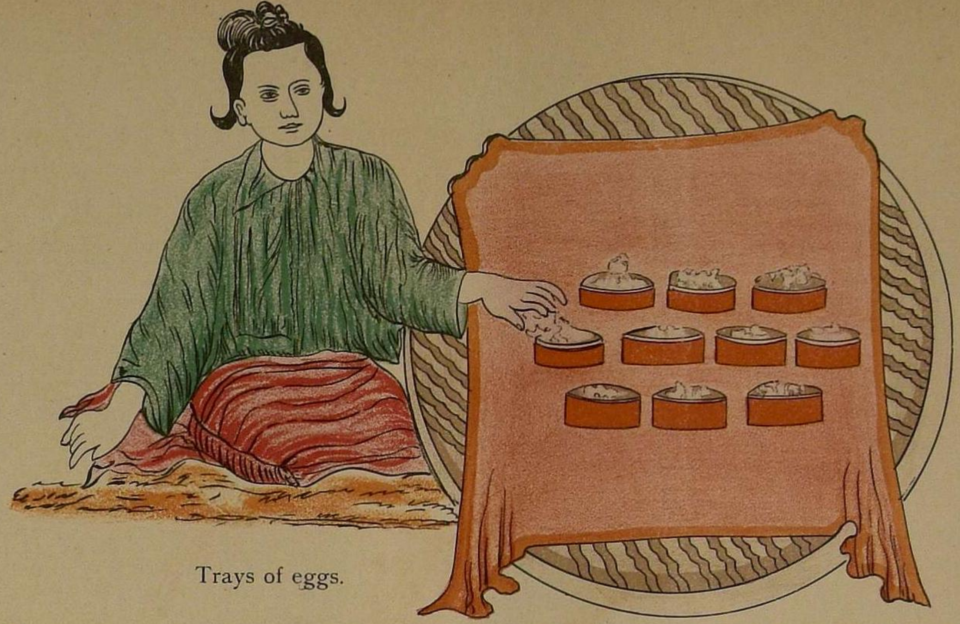
Woollen Fabrics of the Bombay Presidency.—10. Cleaning wool; measuring threads and spinning woollen yarn; sizing the warp. 11. Broach peasant wearing "Ghumti"; woollen hand loom.

Cotton Fabrics of the Bombay Presidency.—12. Cloth loom.

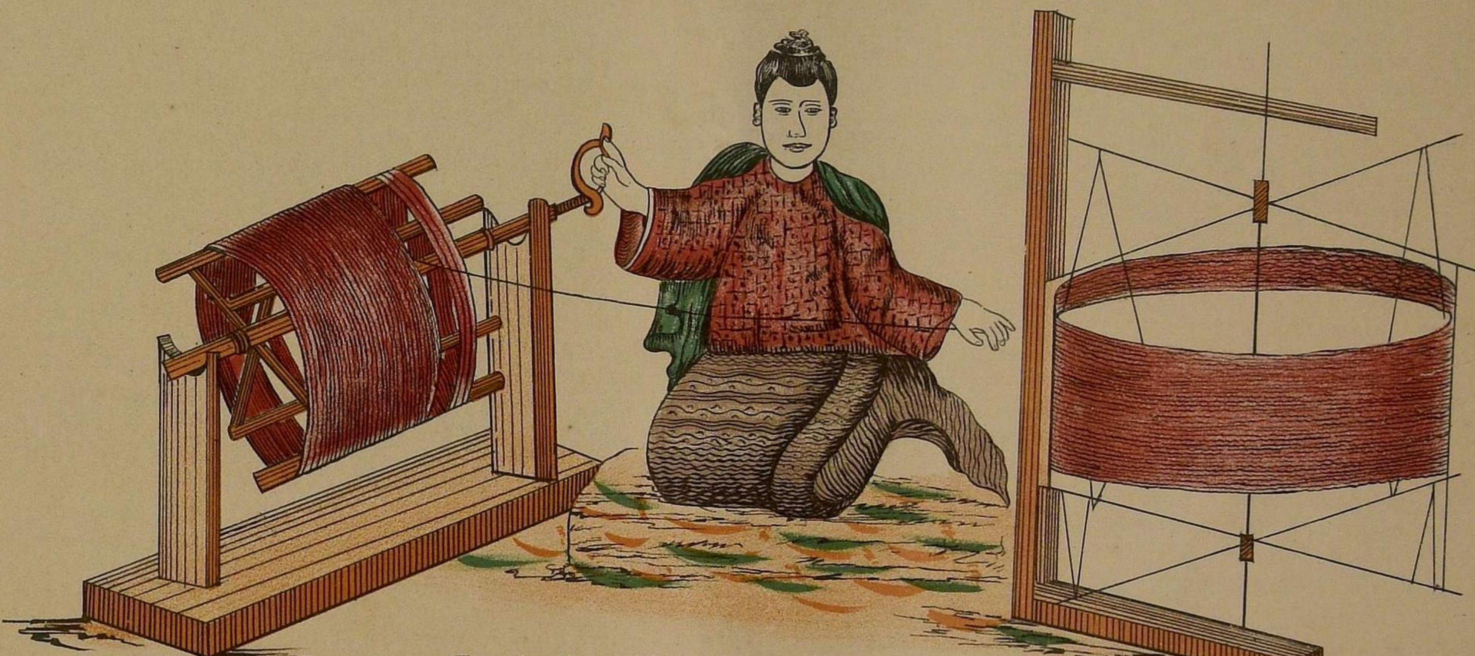
The Cotton Fabrics of Assam.—13. Looms and reels.

Cotton Fabrics of the North-Western Provinces and Oudh.—14. Spinning, weaving, &c. 14*a*. Preparing rice-starch; starching. 14*b*. Straining dye; cotton printing. 14*c*. Dyeing.

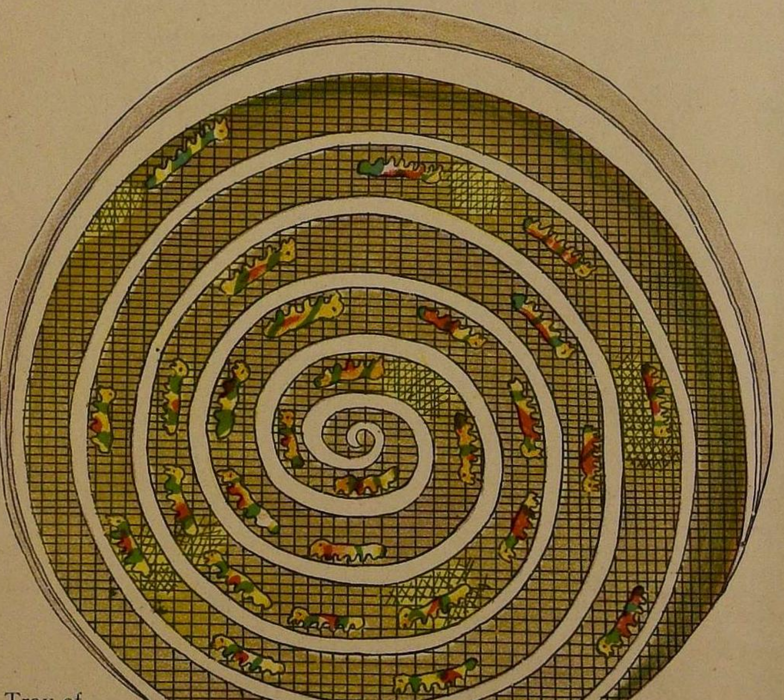
Silk in Burma.—15. Trays of eggs; transfer of raw silk thread to reel; cocoons; reeling the silk. 16. Transferring raw silk thread to reed reel; another method of reeling; baking cocoons. 17. Spinning machine; spinning machine at Kothan; frame used before laying the warp; winding; cleansing silk. 28. Dyeing; frame used preparatory to weaving; another method of winding; loom frame. 19. Winding warp thread; rolling warp threads on to the *leik*; the loom; transferring Singapore silk from one reel to another. 20, 21. Fabrics.



Trays of eggs.



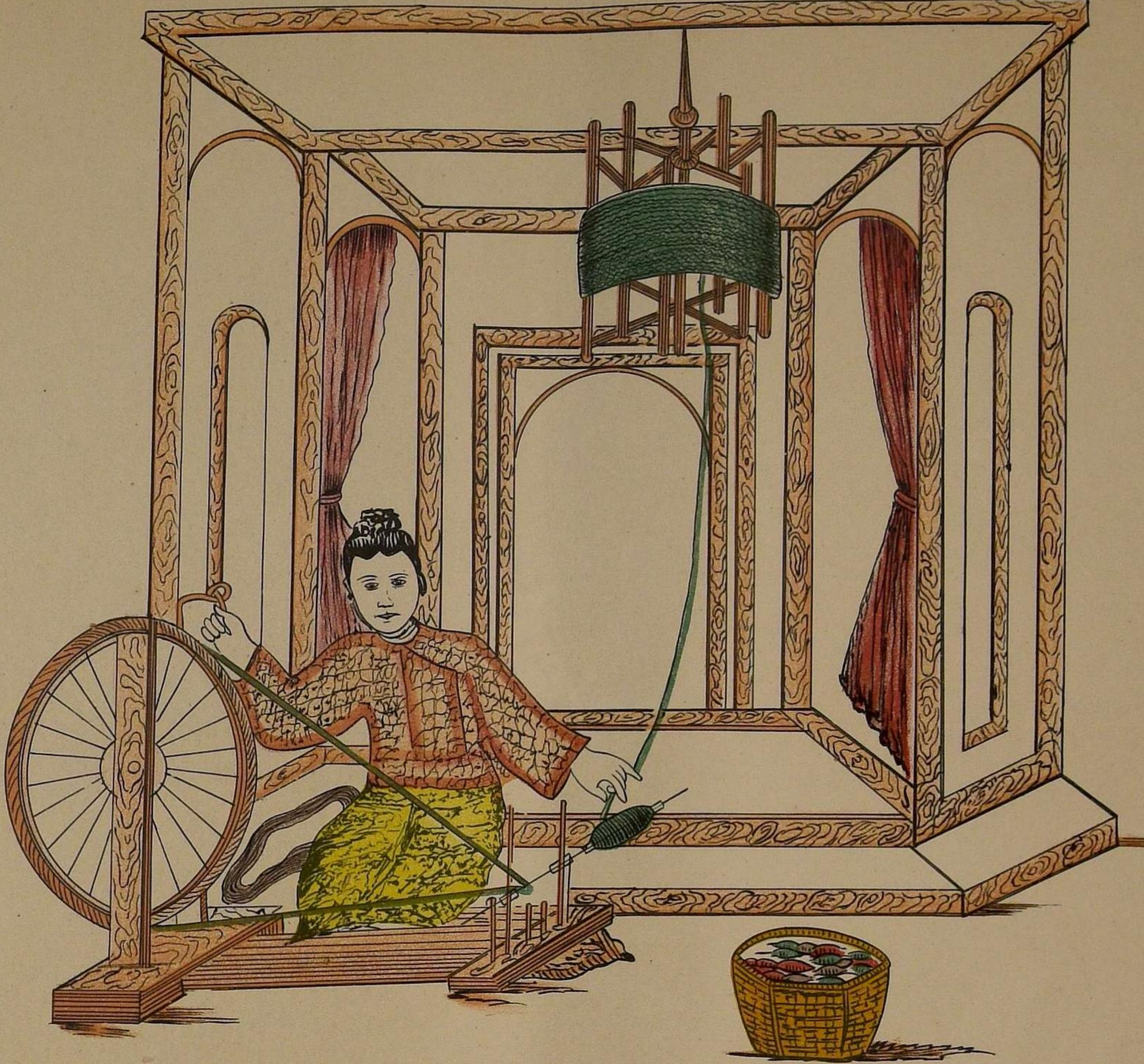
Transfer of raw silk thread on to the reel.



Tray of Cocoons.

Reeling the silk.

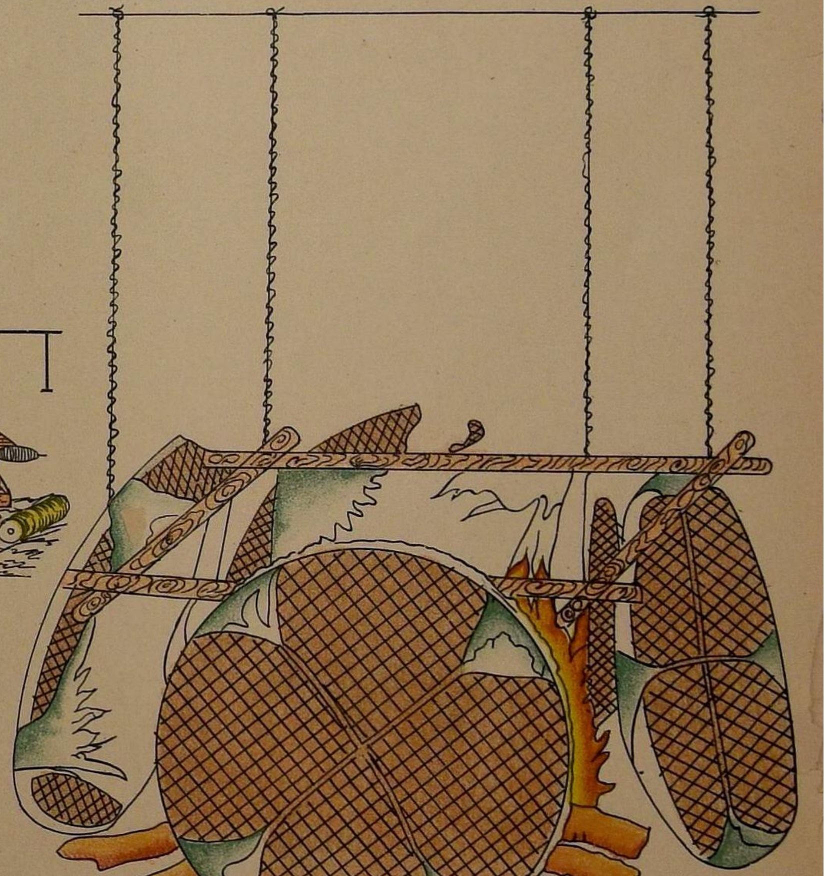
15.—Silk in Burma.



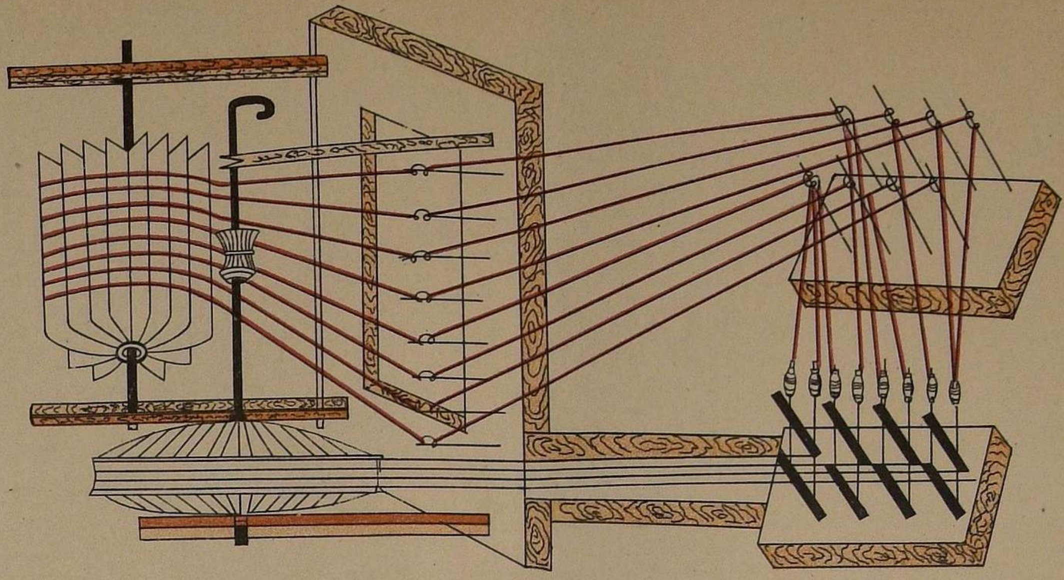
Showing the large reel hung up and the spinning wheel at work, transferring the raw silk thread on to the reed reel.

Another method of reeling.

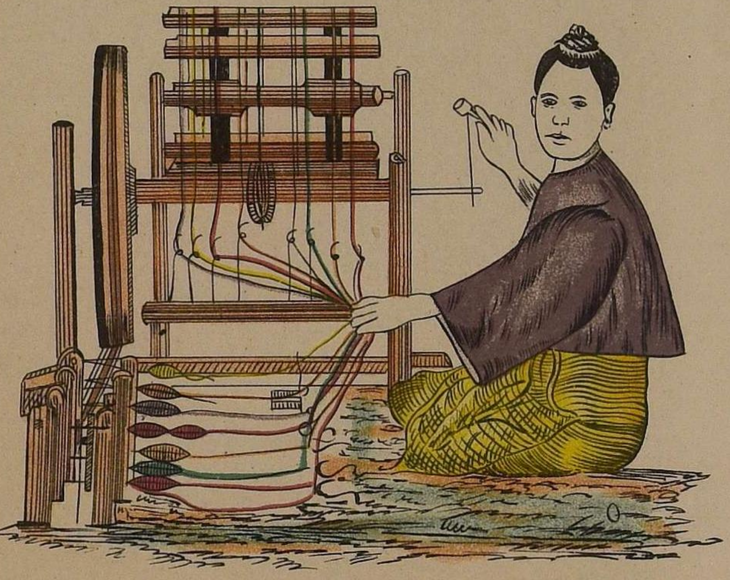
16.—SILK IN BURMA.



Baking cocoons.

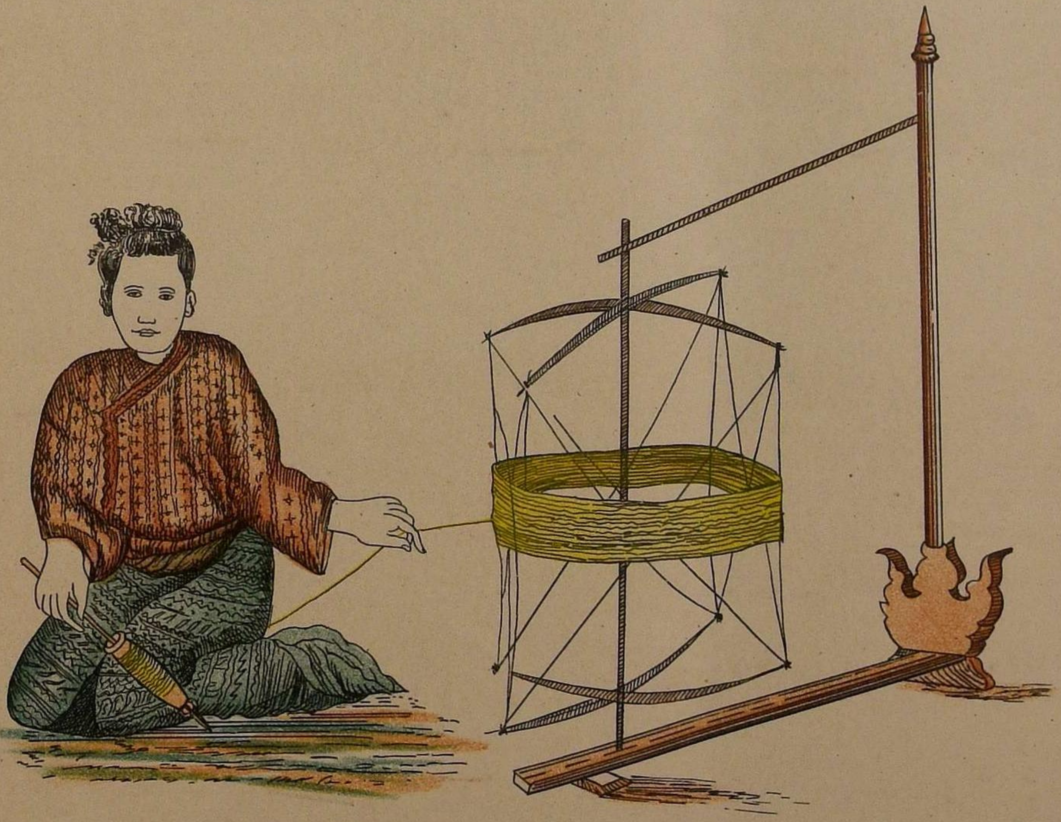


Spinning machine.



Spinning machine at Kothan.

Frame used before laying the warp.

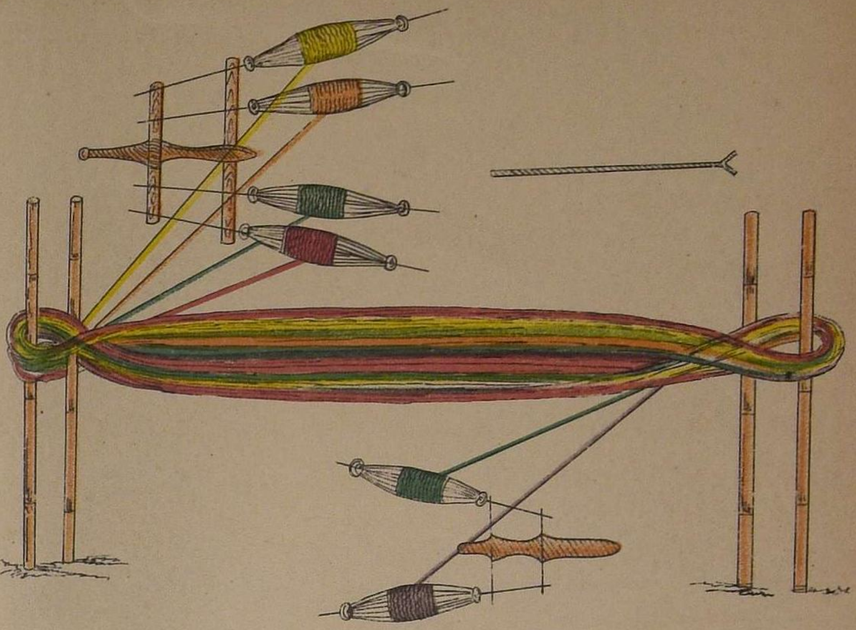


Winding before laying the warp.

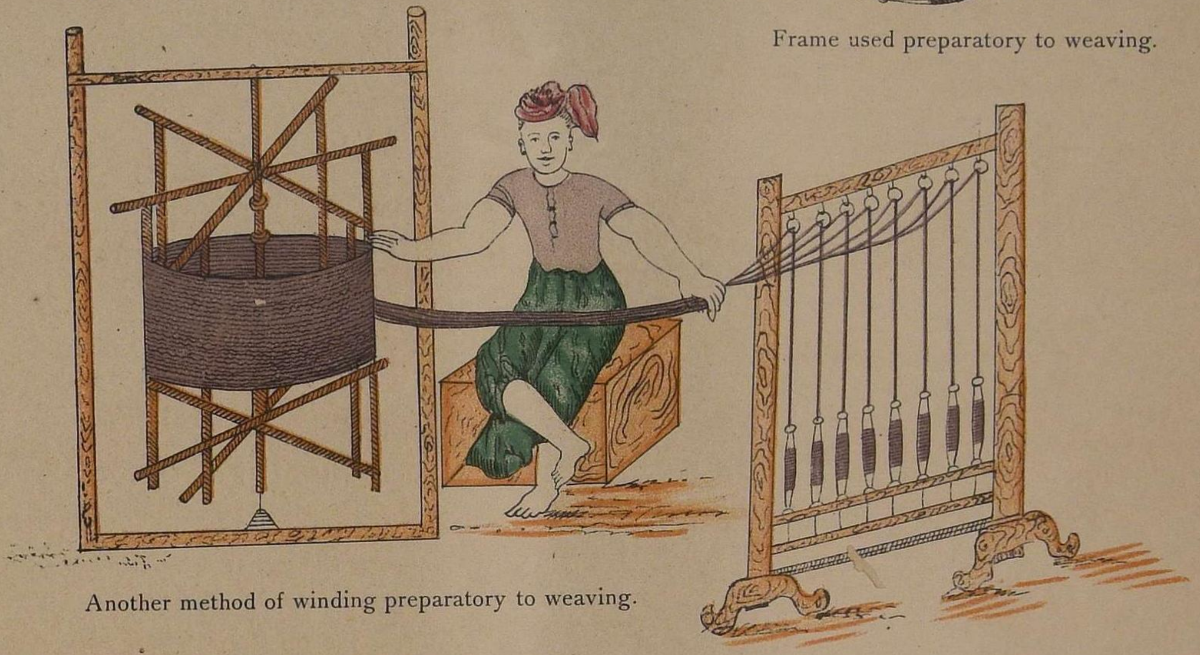
Cleansing silk.

17.—SILK IN BURMA.

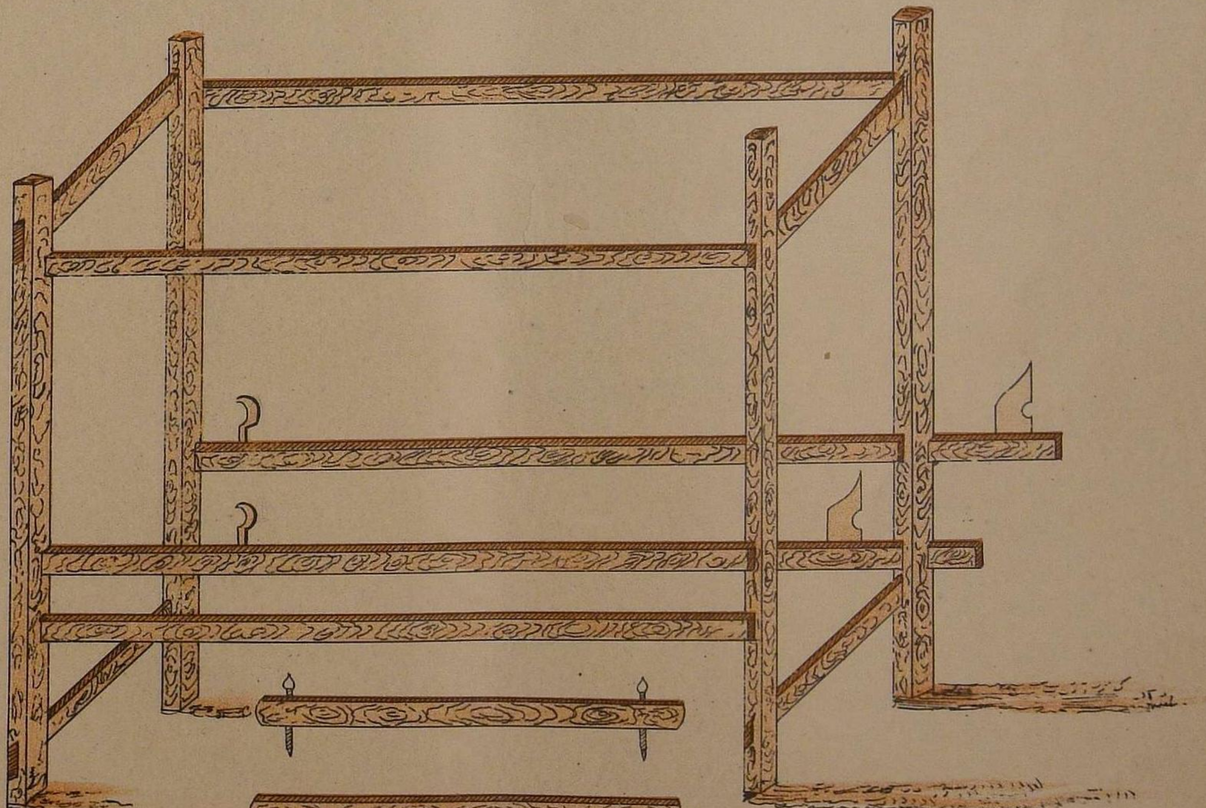
Dyeing.



Frame used preparatory to weaving.

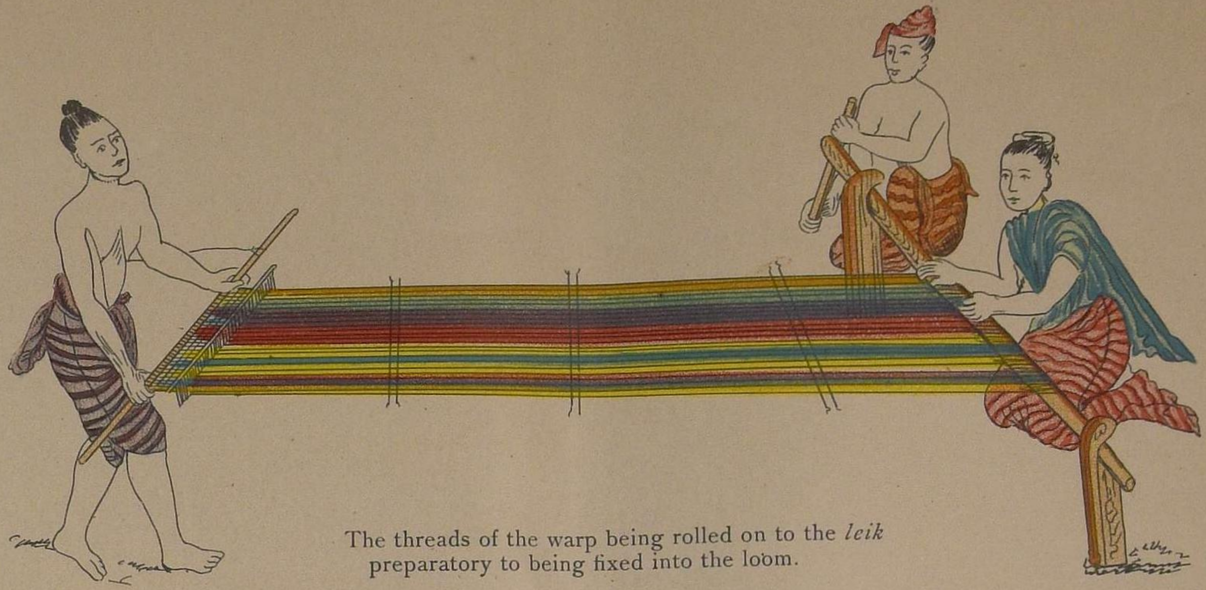


Another method of winding preparatory to weaving.



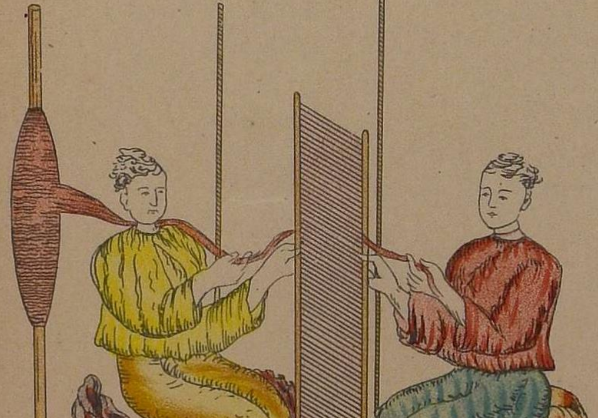
Loom frame.

18.—Silk in Burma.



The threads of the warp being rolled on to the *leik* preparatory to being fixed into the loom.

The loom.



Winding the warp thread.

Transferring small coils of Singapore silk thread from one reel to another.

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20.—Silk in Burma.

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21.—Silk in Burma.

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TO

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INDUSTRY.

IVIE HAMILTON.

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